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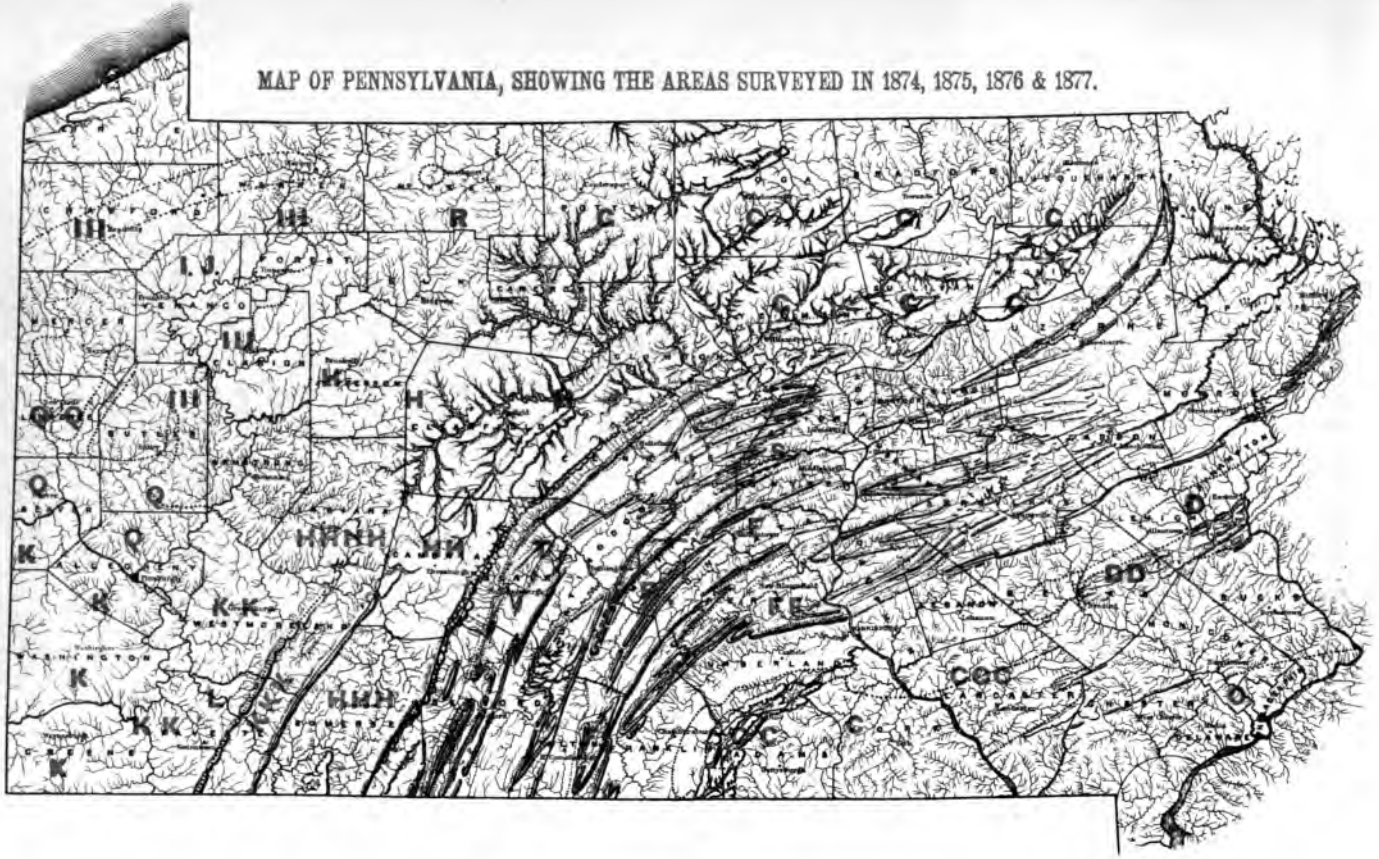
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MAP OF PENNSYLVANIA, SHOWING THE AREAS SURVEYED IN 1874, 1875, 1876 & 1877.



SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA.

HHHH 1877.

REPORT OF PROGRESS

IN

INDIANA COUNTY,

BY

W. G. PLATT,

WITH A COLORED MAP OF THE COUNTY.

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HARRISBURG:
PUBLISHED BY THE BOARD OF COMMISSIONERS
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PHILADELPHIA, *April 30, 1878.*

Prof. J. P. LESLEY,

State Geologist:

SIR: I have the honor to submit my report of the survey of Indiana County.

I desire to make grateful acknowledgment of the uniform kindness shown me by the citizens of the district, as well as for the very material aid and assistance often rendered by them in the prosecution of the work.

I am likewise indebted for much valuable information to Gen. Hermann Haupt, Chief Engineer, and Mr. O. Barrett, Jr. Assistant Engineer of the Seabord Pipe Line Company; Hon. T. St. Clair of Indiana; Hon. A. H. Fulton of West Lebanon; Mr. D. Zach of Homer; Mr. Grumling of Two Lick; Mr. Gardiner of Black Lick; Dr. T. P. Simpson of Pittsburg; Messrs. Creighton and Ransom of the Pennsylvania Railroad Company, and many others.

Very respectfully,

Your obedient servant,

W. G. PLATT.



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PREFACE.

The report of the progress of the Survey in Indiana county now published by order of the Board is an important contribution to our knowledge of the Bituminous Coal Fields of Pennsylvania.

Connections between the geology of the Allegheny river, worked out by the First Survey previous to the year 1841, and the geology of the counties bordering on the Allegheny mountain and the Maryland State line, have hitherto been unsatisfactory because imperfect; the almost unexplored region of Indiana and West Armstrong counties acting as a barrier over which none of our vague hypotheses of identification could pass either way.

Covered as this region is with the Barren Measures, and large parts of it being until recently an almost unbroken forest, mine exposures have always been wanting, and natural exposures difficult to find, and when found hard to collocate.

The first geological survey of Pennsylvania therefore passed by to the right and left of Indiana county, and nothing of account was done in subsequent years to discover its minerals and explain its geology; because the commercial development of its coal and iron wealth was confined to its southern border the Conemaugh river, to the line of the Pennsylvania railroad through Westmoreland county still further south of it, and subsequently to the line of the Low Grade railroad through Jefferson county to the north of it.

The northern extension of the Ligonier valley through Indiana county lay shut up between two ranges of mountain land (Laurel Hill and Chestnut Ridge) far removed from all commercial routes, and was ploughed cross-wise into deep ravines by Black Lick, Two Lick, Yellow creek and their branches. It was in good measure covered with forest trees, and with broken fragments of various massive sandrock formations, any one of which might be and in fact often was mistaken for the base of the Coal Measures No. XII.

The survey now happily completed by Mr. W. G. Platt places the geology of Indiana county in a clear light. Its results not only affect in some points our former vague generalizations respecting this special area, but also our more recent and improved views of the bituminous coal series.

1. Perhaps the most important fact of wide interest described by Mr. Platt in this report is that touching the limits of a deposit called by the First Surveyors the Ferriferous Limestone, coming in between the Clarion and Kittanning coal beds (B and C.*) They adopted this limestone bed as their key to the geology of the lower coal measures in Northwestern Pennsylvania; where it is an almost universally thick rock; showing its outcrop in a multitude of localities; and in most of them supporting the important Buhrstone iron ore. It followed almost as a matter of course that other limestone strata were overlooked, or else confounded with it, to the great confusion of the local geology everywhere.

Under the natural supposition that a deposit, traceable continuously through Beaver, Lawrence, Butler, Clarion, Jefferson and Clearfield counties, and carrying a peculiar and characteristic iron ore everywhere, must needs exist in Armstrong, Indiana, Cambria and Somerset counties, and in the country south of the Conemaugh and Ohio rivers, underground, and must have continuous outcrops along both sides of Chestnut Ridge and Laurel Hill as far as the Maryland line,—under this natural supposition the First Surveyors found it as they supposed in a great many places; although it was nowhere accompanied by its typical iron

* Of my "Manual of Coal."

ore; and although it often seemed to appear in a part of the series which did not closely correspond to its geological horizon in the Allegheny river section.

But when the surveys of Cambria and Somerset counties in 1875–7 had revealed the startling truth that there were several other important and persistent limestone horizons in the lower coal measures and in the barren measures, not one of which could be made to correspond properly with the Ferriferous Limestone and Buhrstone iron ore of the Allegheny river country, it began to be suspected that too large a territorial extent had been ascribed to the latter; and Mr. Platt in this report has turned that suspicion into certainty. A reference to the word "Ferriferous Limestone" in the Index, will guide the reader to his demonstration that this deposit has a well defined southeastern limit beyond which it is useless to look for it, or for the iron ore lying upon its upper surface. It can only be found in the western and northern parts of Indiana County.*

But on page 67† where Mr. Platt states the case, he puts the Ferriferous Limestone bed beneath coal bed B; only on the ground, however, that its normal interval beneath E (250′) would put it there. This is as good as expressing his opinion that while the Clarion coal bed (under the Ferriferous Limestone) is the bed B of the old Allegheny river section, it must not be regarded as bed B but as bed A′ of the Cambria, Somerset, and Indiana reports.

For the settlement of this very interesting point we must await not only Mr. Platt's report on Armstrong county and Mr. Ashburner's report on Elk county, but a revision of the work done in Jefferson county, and a survey of Clarion county yet to be made.

2. The Kittanning group of Coal beds which Mr. White in his reports on Beaver, South Butler, and Lawrence counties (Q and QQ) showed to be *dual*, and which Mr. Chance in his forthcoming report on North Butler will show to be

* We see now why the old Charcoal Iron Region never extended much southward and eastward of Clarion county.

† See also the first paragraph on page 126.

triple, evidently contains three coal beds in Indiana county; and this sub-division I have indicated in the Index, for the convenience of the reader.

3. The relations of coal beds A, A′, B, B′, so called in the reports on Cambria and Somerset counties, to the coal beds A and B, or Brookville and Clarion of the First Geological Survey, are left by this report on Indiana county open to discussion, and can only be settled by a revision of Clearfield and Jefferson counties and a connection with the now perfectly well known series of lowest coals in Elk and McKean counties.

In that northern district Mr. Ashburner has proved the existence of three "conglomerates" with two intermediate coal beds or coalslate beds. The uppermost *c* he calls the *Johnson's run rock*, making the rock cities on the Clarion river east of Wilcox.* The middle one *b* he calls *No. XII*,† very coarse and massive in places where the other two are not. The lowest one *a* he calls the *Olean conglomerate;* it makes the rock cities along the State line. Under the Olean come a very few feet of soft measures which I take with all due reservation to be the representative of No. XI.‡

Under the Johnson run rock lie two layers of coal sometimes united, and hence called by Mr. Ashburner the Twin coal.

Over the Johnston run rock comes the Claremont bed worked at Bishop's summit.

Above this again comes the Claremont and Johnson's run thick limestone.

---

* This seems to be the *Tionesta Sandstone* of the First Survey. It is almost certainly the *Clarion Sandstone* of this Report HHHH.

† Mr. Ashburner proposes for this the very appropriate name of the *Kenzua rock* in his district.

‡ The greenish sandstones which underlie this Mr. Ashburner considers to be Pocono (Vespertine) Sandstone No. X. But I suspect that they may turn out to be the greenish sandy upper portion of No. XI, judging by the careful study of this portion of the Palæozoic column by Mr. Jones in the region around Piedmont, in Maryland, where 10 feet of red shale is underlaid by 300 feet greenish sands and shales, under which again come 250 feet of genuine Mauch Chunk red shale (XI), and under this again 250 feet of Mountain Limestone (XI), at the top of X; corresponding therefore to the 40 to 50 feet of Limestone under the red shales in the Johnstown and Blairsville gaps.

Forty feet higher lies the Johnson's run "Gas coal" bed. If this be C, the Lower Kittanning, then the limestone is the Ferriferous, and the Claremont coal the Clarion (B or B′); and the Twin coal the Brookville (A or A′); the lower coals being unnamed, as "interconglomerate," one of them however probably corresponding to the Mount Savage bed of the Maryland line.*

I here merely indicate the progress of the enquiry to show what is still to be done, and to guard the reader of this report against assuming any identification beyond this, viz., that the beds herein marked A, A′ and B are members of the *Clarion Group*. Which of them are the Brookville and Clarion beds, or the Claremont, Johnson's run, St. Mary's, Daguscahonda, &c. beds we do not yet know with absolute certainty.†

4. Any observation of real nonconformability in coal measures has a marked value for settling the theories of Coal, as much as for determining methods of mining coal beds. The indications of a case of this sort given on page 228 and 229 are important because suggestive of the origin of cannel coal. And our interest in the case there noted is further heightened by observing that it involves a characteristic feature of coal bed D, the representative of the Darlington Cannel bed of Beaver county. Here as there a thick mass of cannel suddenly comes in to overlie a layer of bituminous coal of regular thickness.‡ A dip of 20′ in 150′, or about 840′ to the mile, is here seen. The cause of the ancient

* The resemblance of this section to the generalized section in Indiana county is very satisfactory. The reader will understand that the Twin bed is Mr. Platt's A; the Claremont bed is his A′; then, above the Limestone, the Gaz coal is Mr. Platt's B, which is therefore equivalent to the Kittanning (Lower Kittanning) bed C of the old reports.

† Mr. Ashburner has traced the St. Mary's (Ferriferous) Limestone far enough into Jefferson county to see that it goes under a higher limestone of a character which certainly belongs (like its position) to the *Johnstown cement bed;* and Mr. Platt has recently found the cement bed on the Allegheny river in Armstrong county occupying its proper horizon.

Above the cement bed Mr. Ashburner recognizes a third limestone, which must be either the Lower Freeport or Upper Freeport limestone.

‡ Compare also the sporadic mass of cannel in bed D at the Red Bank colliery in Jefferson county described by Mr. F. Platt on page 243 Report H.

water channel thus revealed is open to discussion; but the fact remains, that these deposits of cannel slate or cannel coal are not of the nature of soil produced by a widespread air breathing vegetation; but are rather of the nature of a carbonaceous mud, deposited in local water ways not effected by erosion but by some very local and not always explained depression.

The theory of the origin of Cannel requires thorough investigation. First, because the carbonaceous mud of which it came may be regarded in two lights: either as a gentle and continuous wash from utterly decomposed land plants; or as a pack (or wash) of non-fibrous water plants. Between these two very dissimilar and even opposite hypotheses one must be preferred to the exclusion of the other. Secondly, because some rational account must be given of the irregularly local and often long and narrow basin in which every such deposit yet known seems to have been deposited.

That these basins were water-ways or pools irregularly scattered over the field occupied by a regular coal bed is evident from many observations in various parts of the coal fields of the United States.

That they were local is no longer open to doubt. But there were more of them existing at once at certain horizons of the Coal Measures than at others.

That they are not filled-up vales or hollows of *erosion* is manifest, for they do not cut into a subjacent coal bed (like ordinary lagoon faults) but only bend it down, so to speak, below its normal level, leaving to it its full or regular thickness. Nor are they accompained by any of the well known evidences and relics of current waters. Everything about them betokens a quiet, peaceful condition. The mud is fine; the slates are laminated and regular; the roof is soft. The pool was one of almost standing water.

What then caused the depression? How could a dead level bituminous coal bed get a local dip of five or ten degrees at the sides of such an area of depression?

Many years ago Mr. Lesquereux described the *floating* sheets of vegetation, strong enough to support trees, now growing in the Dismal Swamp, and inferred that a similar

condition of things existed in local portions of a swamp vegetation in the Coal Era. When the forest becomes too heavy to be borne the floating mass sinks to the bottom, and the trees perish standing, being submerged for many feet or yards of their boles. Sooner or later they are overthrown by the wind. Fine mud then gradually collects over their prostrate bodies and over the dead vegetable raft which had so long sustained them in the air, and which now begins its chemical history, its metamorphosis into a future coal bed.

Existing peat bogs enjoy a vigorous growth on hillslopes of several degrees inclination in countries like Ireland where the air is constantly saturated with moisture. They push out from the edges of small ponds until they cover them and subsequently fill them. If the Carboniferous plain consisted of broad lowlands and shallow ponds, through which rivers meandered, the vegetation of each coal bed must have conformed to this slightly accidented, generally horizontal, but yet dimpled surface.

If this surface were elevated much above sea level we should find no marine fossils; small rivers would have been numerous and large rivers few, but their channels boldly marked and deep. And we should have had but one coal bed.

If the whole plain stood at any one time at sea level, its vast expanse (known to have been 1,000 miles long by at least 300 miles and probably 1000 miles wide) must have kept the real ocean at a great distance from its interior regions, and consequently most of its waters, fed by daily continental rains, must have been fresh.

Now any local dips, if such existed, measuring even 1° (to say nothing of 5°) in such an area could not have been caused by movements in the earth's crust considered as a whole. This may be made evident in a moment by constructing a diagram to show such a dimple as that described on page 228 of this report supported by 10,000 feet of palæozoic formations underneath it. No true "subsidence," as referable to the figure of the globe, is here conceivable. To find "subsidences" in this sense we must

seek for them in the long straight basins between the great anticlinals.

Nor may local subsidences as due to the chemical dissolution of areas of the Mountain Limestone (XI) or of the Devonian and Silurian limestones (VIII, VI, II) be less out of the question; 1. because of the absence of the Mountain Limestone (XI) from the underground of Indiana county: 2. because of the enormous depth of the others. For even if any waters could dissolve them at that depth, the roofs of any, even the most gigantic, caverns in them would at the height of the coal measures stand firm forever. I have elsewhere shown my reasons for believing that the erosion of the Appalachian Valleys, of the Blue grass country of Kentucky and Tennessee and of the Northern Lakes can only be explained by the chemical solution of the great limestone formations. But I have also described the process as going on only near their outcrops, constantly receding from the axes of anticlinals. Such a process would be inconceivable as occurring under a horizontal covering of coal measures. Therefore any "cavern theory" for such irregularities in the horizontality of our coal beds must fail to afford us the desired explanation.

The subsidence of a float of vegetation to the bottom of a pool when the water could no longer support it may perhaps account for most of the cases recorded or observed. Then, after the water was freed from its covering, streams from the surrounding peatbog and forest might bring in such a quantity of macerated vegetable matter as would suffice, in combination with a growth of genuine water plants, to explain the black slate roof, so characteristic of our coal beds, and in exceptional cases (or under exceptional general conditions of which we know little) our local deposits of cannel.

The subject is certainly not thus freed from all its difficulties. But we may feel that we thus obtain a reasonable hypothesis for further investigation. It is very difficult to get at the information which we want respecting these curious deposits. Common cannel is seldom a marketable mineral; and mining operations, when they are pushed at

all into these deposits, are economically practicable only in the centre of a limited area, where the bed is thickest; the gangways invariably stop before reaching its edges, just when we are watching their revelations with the most interest, namely at such distances from the centre where the bed becomes too thin to work to a profit. We know therefore almost nothing of the nature of the edges of a cannel coal bed; and are left in the dark as to its side connections with the bituminous coal bed on which it often rests. Natural outcrops exist, and would give us this information just as well as underground drifts; but these natural exposures of the knife edge termination of a cannel bed are covered by soil, and are not accounted worthy of exploration by those who contemplate mining.

To pursue the subject one step further—it is easy to see how the ponds or pools suggested above would get filled up. But it is a standing puzzle to devise an acceptable hypothesis for the submergence of a continental plain of Coal Vegetation to a depth of say 50 feet below sea level; for this seems to be a necessary preliminary condition for the production of a second coal bed over-spreading the first at that height. It is still more troublesome to imagine rightly the cessation of such submergence at a fixed point, and for a time sufficiently long to permit the growth of such a second bed; and then the repetition or continuation of the general subsidence to produce the next rock interval up to the third coal; and so on for all the intervals and all the beds of the Carboniferous age.

If a depression of a large portion of the crust of the earth, with or without earthquake paroxysms, be imagined, as is commonly done, it is amazing to contemplate the regularity of such a movement over a large area, implied by a fact like this, viz. that a constant normal thickness of 300′ for the productive coal measures holds good over eight or ten counties in western Pennsylvania.

Yet this "slow depression theory" has too many good arguments and apt uses to be easily rejected. We see such movements going on at the present day, and they may be observed, and have been actually measured by good observ-

ers, on many of the existing sea coasts : no doubt accompanied by slow changes of level of the inland country, and also of the bed of the ocean, which our instruments of altitude and sounding are not fine enough to detect. They are only visible by traditional water-marks along the coast.

The theory of subsidence during the Coal age allies itself also with the great fact of the violent, although perhaps tolerably slow, elevation of the United States and other countries, far above the sea level, at the close of the Coal age. In this we have an exaggerated reverse *upward* movement to what had been before a *downward* movement, not only during the Carboniferous, but during the long preceding Devonian and Siluvian ages. Without this we cannot guess how from 20,000 to 40,000 feet of Palæzoic sediments could have found sea room to be deposited ; especially seeing that some of them were evidently deposited in very shallow water; exhibiting as they do quasi oyster beds, coral reefs, reptile tracks and even rain drops and wave furrows.

But it will be well to keep the attention alive to the possibility of another hypothesis, based upon a rise of sea level rather than upon a descent of ocean bed. Geologists have been so engrossed by ideas springing from their familiarity with upward and downward earth-crust movements, that little study has been bestowed upon what must also have in some manner or other played an important role in geology : *the physical consequences of filling up a water basin with mud, sand, coal, limestone, &c.*

If such a basin be *closed*, then certainly when foreign materials are introduced to fill it up, the level of water in it must rise in proportion to the deposits it receives ; and the area of the basin must also be enlarged. This inevitable result can only be wanting in case the basin, however large, be open to the general sea. Whether the great original coal basin (now subdivided by changes of the figure of the earth into separate Coal Basins properly so called) was open or shut to the sea, may be a question we can never answer. But it is a question to be asked, and any possible right answer must exercise an influence upon the

final theory of the origin of coal, with its thousand embarrassing side issues.

I have drawn a sharp distinction between basins closed from, and basins open to the sea. But there really exists no such sharp distinction; for every cubic yard of materials abstracted from the upland and deposited in Delaware Bay tends to raise the level of all the oceans of the world by a fixed quantity.

Considering the apparently large amount of such materials carried out to sea by all rivers one might anticipate that this quantity when known might be a notable basis for a calculation startling enough in its results; for if it amounted to but an inch a year the sites of many of the great cities of the world would be under water in a few centuries from now. Yet their relative levels to the surface of the ocean seem to have remained constant for thousands of years. Let us however make the calculation and note the insignificant results.

The water surface of the globe amounts to about 133,000,000 square miles. The Mississippi river pours into the sea 145½ cubic miles of water, holding .0035 of its bulk as suspended sediment, and rolling probably a larger amount along its bottom.* This would make an annual deposit of one cubic mile of sediment. Multiplying this by 50 to represent the annual contribution of twenty other very large rivers of the world and hundreds of smaller rivers entering the oceans, we may suppose the total annual sediments of the globe to amount in bulk to 50 cubic miles.

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* Even if recent attacks made against the accuracy of the United States report on the Mississippi river be successfully maintained, in whole or in part, the argument for an insignificant secular theoretical elevation of the sea level is not materially affected, but only a certain percentage of the amount must be added or deducted.

The same may be remarked of other functional elements of the discussion: such as the relation of bulk of matter considered as solid and homogeneous to the bulk of a sand or gravel deposit permanently charged with water; the amount of compression endured by deposits; change of bulk from chemical and other causes; appropriation of dissolved matters by plants and animals, and consequent ejections into the atmosphere or absorptions from it; the fall of cosmical solids from space, &c. &c. The geological theme under discussion here is not materially affected by any of these.

The annual rise of the sea level due to such a deposit would measure 0.022″ In other words it would require a little less than half a century to change the general level of the sea water on the globe one inch; and during this lapse of time movements of the crust might and undoubtedly would alter the relations of land and sea along the coast infinitely more, in either direction.

It is evident then why geologists always ascribe such changes of relation to some alteration of the figure of the Earth, and confine themselves to a study of earthquake phenomena to find some explanation of both secular and paroxysmal subsidences or elevations of such areas as that of the Coal measures. Earthquakes testify to the fact that such movements are paroxysmal as well as secular; and the intervals between coal beds seem to give us a measure both of the frequency and magnitude of such paroxysms in ancient times.

It is a notion common to geologists with all other men, that the ocean level is an unchangeable datum. Any suspicion, or even any confident belief to the contrary, is too feeble or seems too impracticable to have weight or to claim careful consideration in the discussion of structural problems as they successively present themselves in the advance of our knowledge of earth areas.

Nevertheless, the most elementary teaching of hydrostatics informs us that no movement of the earth crust, no slightest alteration of the figure of the globe can take place without some shortening or lengthening of the earth's radius, measured from its centre to some point on the surface of the sea. That means some fall or some rise of our universal datum of land-height measurement. Let us take an instance.

When South America emerged from the waves, the water which had been covering it transferred itself to all the open oceans, raising the sea line upon all shores, and submerging a certain number of lowlands. But the amount by which this operation raised the general level must have depended upon the gross quantity of water thus transferred.

The mean depth of ocean water under which South

America lay in tertiary times is unknown. If we suppose it to have been only 100 feet over 6,000,000 square miles, and the general ocean area of the world, (as now,) 133,000,000 square miles, then the general sea level must have been raised $\frac{6}{133}$'=about *four and a half feet.* If, however, its mean depth was 2400', then we must suppose a general rise of *one hundred* feet.

This example will suffice to illustrate the absolute necessity of a change of sea level, but also the impossibility of any computation of the *quantity* of such change produced by any one of those great geological earth movements to which we owe the appearance of land.

A change of sea level, however, must have often taken place in a reverse sense. The settling of belts of Pacific, Atlantic, Indian ocean bottoms in past ages, (of which atolls &c. are the well recognized monumental proofs,) has in every case caused a drainage inwards *towards such deepening parts of the ocean bed* of the waters of all other parts of the globe; *lowering* the universal sea-coast line by some proportional quantity; which, again, we cannot calculate, for want of specific data.

There is, again, another method by which the actual sea level has undoubtedly been changed in recent geological times, and perhaps repeatedly in the history of the globe, viz: by the abstraction of water from the sea to spread snow and ice fields of great thickness and extent abroad upon the land. And this has been much insisted upon of late.

Some years ago, when Mr. Agassiz first proclaimed his belief that the northern hemisphere was covered with a continuous glacier, the front end of which projected into Long Island Sound, and overtopped the highest peak of Mount Desert by at least 2000 feet, I estimated the height of the snow mass necessary for producing the supposed motion of this glacier at 20,000 feet at the pole; and that the abstraction of that amount of water from the sea would lower the sea level over the whole globe about 600 feet.

It is now generally allowed that no such universal ice cope ever existed, but only that certain large isolated areas

of the continents were thus covered by ice. Nevertheless, it is a proven fact that the highest mountains in Northern New Jersey and Eastern Pennsylvania were actually covered by a solid sheet of southward moving ice of unknown thickness.

The sea level, therefore, certainly stood lower in the Glacial age than it does now; and it is evident that were all the snow fields and glaciers still existing in Alpine regions, small as they are in comparison with those of the Glacial age, were melted, their water would find its way into the sea, and slightly raise its general level.

During the last season, the United States Fish Commission learned through Mr. Warren Upham, whose researches in New Hampshire have cast so much new light upon the nature of osars and other phenomena of the Glacial Drift, that late tertiary beds stretch from Cape Cod to the New foundland banks, at depths varying from 300 to 1500 feet. These are probably a continuation under water of the beds of Southern New Jersey, Delaware, and Virginia.

The shape of the New York harbor tide-way out at sea shows that the sea surface level stood many hundred feet lower at a comparatively recent time than it does now.

The dredgings of Count Pourtales for the Coast Survey in the southern gulf stream waters have demonstrated the same fact a thousand miles further down the coast.

A still more striking example, and one directly bearing on our subject, is presented by facts noticed at the Bermuda islands.

Bermudas is an atoll, or annular coral reef, which has grown around the summit of a huge conical (perhaps volcanic) mountain mass standing isolated in the Atlantic ocean, the bed of which all around it is 15,000 feet deep. It is covered with vegetation growing but a few feet above the present sea level. But a change of sea level of at least 45 feet has been shown; for in excavating for the floating docks, the workmen, after passing down through rock, that far below low water mark, came to a bed of peat, with stumps of cedar trees standing erect as they grew—"conclusive proof * * * that the Bermudas have * * *

sunk since they have been covered with a similar vegetation to their present one."*

Most geologists will see in this striking instance of the formation of two successive coal-beds, separated by 45 to 50 feet of rock interval, a proof of the correctness of the theory of subsidence; for it must be granted as in the highest degree probable, that if the mountain of Bermudas *has* sunk, then the whole bed of the Atlantic has subsided, and thus we get something very analogous to the supposed sinking of the Coal Area in the Carboniferous age. For the relatively disproportionate *sizes* of the little mountain-top peat bogs in the one case, and of the 100,000 square miles original area of the Pittsburgh Coal bed in the other case, can have nothing to do with the argument, and may be left out of view.

But on the other hand, it is evident that a rise of 45 feet in the sea level would equally well furnish an explanation of the facts observed in both cases; and in the case of the Bermudas, that rise of sea level *might* find its explanation in the disappearance of the continental ice-covering at the close of the Glacial era.

Here I willingly leave the subject, since my only object is to bring its various aspects to the attention of the members of the corps, to stimulate their inquiries, and prevent facts bearing on it from being overlooked in the prosecution of our survey.

5. The Colored map of Indiana County was prepared from existing county and township maps of a very imperfect kind on which the outcrops of the Pittsburgh Coal bed and Upper Freeport Coal bed were laid down as best they could be.

Fortunately the course of the Conemaugh river could be and was adjusted by reduction from an extensive railroad survey map in MSS. found in the engineers office of the Pennsylvania R. R. Co. and loaned with his habitual courtesy for this purpose, with other data, by Mr. Wilson.*

It would be a desirable and natural part of the work of

*Review of the Challenger Expedition reports in the Athenæum for Dec. 1.

the Second Geological Survey to publish this topographical map in a completed state, constructed as it was for the express purpose of showing the more delicate features of the surface for geological purposes.

J. P. LESLEY.

PHILADELPHIA, *Nov. 21, 1878.*

*The history of the loss for many years and recent reappearance of this map is curiously illustrative of the perilous existence of manuscript work. I was occupied two years in its construction and left it in an incomplete state. It is covered with barometric and vertical circle contour curves filling in transit location lines, and it is extensive enough to take in the gaps of the Conemaugh, Saltsburg and Latrobe.

The rock fault at the Millwood Shaft.

On page 278 of this volume allusion has been incidentally made to the extensive rock fault existing in the Pittsburg Coal bed at Millwood. The Millwood Colliery, owned and operated by the Millwood Coal and Coke Company, is in Westmoreland County, about five miles south-west from Blairsville, and is therefore outside the district treated of in this Report; but as the circumstance is of general interest a brief description of it is herewith appended.

The maximum width of the rock fault as revealed by the cross-entries of the mine is 120 feet; its average width is about 100 feet. Lengthwise, a passage way for drainage purposes was cut along the outer edge of the line for several hundred feet; and far beyond the end of this, in one of the workings of the mine that attempted to cross the line of its path, it was met with in full force. Hence for a distance of more than 1200 feet the existence of the rock fault has been sufficiently proved in a direction of N. 21° E. and S. 21° W. or parallel to the synclinal axis of the basin, which passing close to Millwood, makes the dips in that region insignificant.

The sides of the rock fault incline at never less than 20°, and sometimes even at a higher angle than this, so that the change is necessarily rapid, and takes place within a comparatively small area. The roof rock of the coal is a grayish clay shale, which throughout the mine generally, is very regularly and evenly deposited. But at the edge of the fault, without any apparent increase of thickness either in the coal or shale, this roof shale descends suddenly through the bed, which it cuts out entirely, ending in the underlying fire clay, where it spreads out as a broad floor. Here and there, at the centre of the fault, wedge shaped masses of sandstone protude into the shale, coming from the still higher Pittsburg Sandstone; such occurrences of sandstone are, however, exceptional, the fault consisting mainly as above stated, of tough shale. In the shale also, but only *at the edges of the fault*, are small lenticular masses of coal, projecting from the main bed, though entirely disconnected from this; these masses of coal are simply fragments of the

main bed, long ago detached from it, by the water which brought in the mud to make the shale.

At the edges of the disturbed line the coal is eight feet thick,—about the average height of the Pittsburg bed, not only elsewhere in this mine, but throughout this region generally. Close to the fault the coal has a peculiar structure totally unlike that it presents away from the fault; it has a twisted and gnarled appearance, while occasionally it exhibits small upright triangular columns, in connected form, and about 6 inches high, looking like diminutive rows of basaltic rocks. Moreover the coal, at the edge of the disturbed line, is hard, compact and has little or no lustre; while so much slaty matter here enters into its composition that it is difficult to ignite, and when ignited has little value as a fuel. These conditions continue, but with intensity decreasing inversely as the distance from the fault, until at 400 feet from the disturbed line all traces of the trouble have disappeared, and the Pittsburg coal bed is found in superb condition, composed of excellent coal, easily and cheaply mined, and unusually free from damaging impurities of every kind. In substantiation of the latter assertion Mr. McCreath's analysis of an average specimen of the coal may be cited*, but still better proof of it is the excellent reputation which the coal from the Millwood Shaft now bears in the market. For a considerable period after these works were started the existence of the fault was unknown, and as, by a curious chance, the shaft had been located close to the fault (had it been placed 100 feet further east, it would have passed through the horizon of the Pittsburg coal, without exhibiting a single trace of it,) the entries and rooms were at first operated entirely in the disturbed area, and the reputation of the Millwood coal was well nigh ruined. But after the discovery of the fault the Superintendent of the Company, Mr. R. G. Ford, (to whose courtesy I am indebted for the opportunity of making the examination) energetically pushed the workings of his mine as far as possible from the fault, with the results above recorded.

*See Report K.K. p. 57.

REPORT OF PROGRESS, 1877.

INDIANA DISTRICT.

PART I.

INTRODUCTION.

CHAPTER I.

The Physical Features of the District.

Indiana county occupies the centre of western Pennsylvania and its Bituminous Coal Field; having Jefferson county on its north, Clearfield and Cambria on its east, Westmoreland south, and Armstrong west.

The Conemaugh river (called Kiskiminetis, below the junction of the Conemaugh and Loyalhanna rivers,*) makes the southern boundary of Indiana county, from the centre of the gap through Laurel Hill to Salina P. O., three miles below Saltzburg,—28 miles in a straight line.

The western boundary line has a straight course from the Kiskiminetis river N. E. 20 miles, to the head of a small run, a branch of Crooked creek; and thence due

*The change of name is marked by Conemaugh township in Indiana county, adjoining Kiskiminetis township in Armstrong county.

north 9 miles to a hill on the north bank of the Mahoning creek. *

The northern boundary line runs due east 21¼ miles to the western north and south line of Clearfield county, on the high divide between the head waters of the Mahoning and Bear run, Whiskey run, and Laurel run, which flow east into the Susquehanna river. The county corner is about 3¾ miles east of the village of Washington, and 8½ miles east south-east from Punxatawny in Jefferson county.

The eastern boundary line runs due (?) south 13 miles to the Cherry Tree Corner (Grant Post Office) where Cushian creek enters the Susquehanna river. Thence south 15° west 23 miles to the Conemaugh river in the center of the gap below Johnstown, and at the crown of the anticlinal.

Indiana county is subdivided into twenty-four townships, eight of which in its northern part are arranged with regularity in two tiers, four in each; the remaining sixteen with less regularity; and the whole somewhat as follows:

W. Mahoning.	N. Mahoning.		Canoe.	Banks.
S. Mahoning.	E. Mahoning.		Grant.	Montgomery.
Washington.	Rayne.		Greene.	
Armstrong.	White.		Cherry-hill.	
Young.				Pine.
Conemaugh.	Centre.	Brush-valley.		Buffington.
	Black-lick.			
	Burrell.	W. Wheatfield.	E. Wheatfield.	

Indiana county has an area of 770 square miles, or 492,800 acres; was set off from Westmoreland and Lycoming counties in 1803,† and contained a population in 1860 of 33,687, which had increased in 1870 to 36,138.‡ This gives about one person to fourteen acres. Large tracts of land within the county lines, especially on the eastern and northern side, still belong to the unreclaimed forest region of Pennsylvania; lying at an elevation of two thousand feet above the sea; much broken by mountain slopes and narrow ravines; encumbered with fragments from the outcrops

* This line prolonged north forms the entire west boundary line of Jefferson county.

† Its county seat, Indiana, in 1805.

‡ Gray & Walling's Atlas of Pennsylvania, page 11.

of the massive conglomerates and coarse sand rocks of the Coal Measures; and overshadowed by pine and hemlock woods and laurel thickets in wet places.

The lower lands of the southern and western townships are under cultivation, but retain an abundance of forest, chiefly of secondary, deciduous growth; a country of hills and valleys, abounding in coal beds, lying horizontally, and outcropping above water level.

The following brief description of 1. The Topography of the surface; 2. Of the Drainage system of the principal rivers; 3. Of the ascertained Levels above tide; 4. Of the Soils and 5. Forest growth; 6. Of the Mineral resources; and 7. Of the Railway and other avenues to market, will suffice to prepare the reader of this report for understanding the Geological structure of the district described in Chapter 2, and for the detailed description of the Geology of the different townships given in the chapters which follow.

1. *Topography of the Surface.*

A traveler from the east, in a Pennsylvania railway train, descending the left bank of the Conemaugh river, from Johnstown in Cambria county, enters a narrow, deep, and winding gorge cut through a mountain called Laurel Hill. At the bottom of the gorge flows the river, on the right bank of which may be seen remains of the old abandoned State canal. The side slopes of the gorge are steep and covered with fragments of sandstone and shale, which have slid down from cliffs at the top of the gorge on both sides of the river. At the centre of the gorge, these cliffs are more than a thousand feet above the bed of the river, and show plainly the structure of the mountain, for they form a regular arch about five miles wide, measuring from where the cliff rocks (Pottsville Conglomerate, No. XII, the Millstone Grit of English geologists, the base of the Coal measures,) rise from the river at the Johnstown or eastern end of the gorge, to where they descend again into the river at the New Florence or western end.

The Indiana Cambria county line, meets the Westmore-

land-Cambria county line in the bed of the river, under the centre of the arch. One county line runs up the steep northern slope to the top of the mountain; the other county line runs up the steep southern slope to the top of the mountain; and the highest points on the two lines facing each other on the opposite summits of the gorge are about 1,200 feet above the river bed, and 2,300 feet above sea level.

After issuing from the gorge of Laurel Hill, the river (and railway, still following the left bank in Westmoreland county, the opposite bank being in Indiana county) crosses the so-called Ligonier valley (and Coal basin) and enters a second gorge, of precisely similar character, cut through another mountain called Chestnut Ridge, exactly like Laurel Hill; with similar slopes and cliffs; showing a similar arch of nearly equal width and height. From the village of Bolivar at the east end of this gorge to the descent of the cliffs at its west end (opposite Blairsville Junction R. R. station) is again about 5 miles, and the coal bed at the top of the fine cliffs on the northern mountain is about 1,000 feet above the river bed, or 2,100 feet above tide.*

Chestnut Ridge and Laurel Hill are therefore two parallel and similar ranges of mountain, cut through transversely by the Conemaugh river, in its way to join the Allegheny river at Freeport. Each mountain is a vault, or anticlinal, of sub-carboniferous rocks, roofed with the Conglomerate, and supporting the Lower Coal Measures on each flank.

From the centre line or axis of the Laurel Hill to the axis of Chestnut Ridge, the distance (directly across the Ligonier valley, or in a direction W. N. W.) is almost exactly ten miles. The direction of the axes, and consequently of the mountains, is about N. 30° E., S. 30° W.

The crest of Laurel Hill runs through Cambria county, because the Indiana county line bears away more northward, and slips down the west flank of the mountain.

*The railroad track at Blairsville Junction is 1,113 feet above tide. See Allen's Levels, Report of Progress, N, p. 5. The river bed is here about 100 below the track, and the southern mountain top about 1,000 above the track.

The crest of Chestnut Ridge runs through W. Wheatfield, Brush-valley, Cherry-hill, Green, Grant and Banks township to the north-east corner of Indiana county.

But the strong distinction which is observable along the Conemaugh river between these two ranges of high land (Chestnut Ridge and Laurel Hill,) and the lowlands between them (Ligonier Valley) is in a good degree obscured in the country to the north by the gradual filling up of the Ligonier Valley to a level with the mountains on each side; so that the whole north-eastern part of the county becomes a broken, mountainous, table land, in which the Susquehanna, Mahoning, Crooked Creek and Black Lick head waters take their rise. And here the forest of Indiana county spreads itself out, and passes over into the still wilder regions of southern Jefferson and western Clearfield counties.

Returning to the Conemaugh river, where it issues from the western end of the gorge of Chestnut Ridge, the observer may now follow its course meandering between steep hill sides, through the great open country of Western Pennsylvania. There are no more mountains, neither in Westmoreland county to the south nor in Indiana county to the north of it. The hills bordering the river are three or four hundred feet high; but back from the river the general surface of the country rises towards the county seat, and insensibly merges into the elevated plateau of the north-east townships before mentioned.

Chestnut Ridge is cut through by other streams besides the Conemaugh river, and similar gorges are the consequence, but they are neither so deep nor so long.

The Black Lick gorge is the first of these going north, and 5 miles distant from the Conemaugh. The stream is large, and drains not only a belt of the Ligonier or Armaugh valley, but a district in Cambria county, the south branch of the Black Lick making a corresponding wild gorge through Laurel Hill, 6 miles to the north of the Conemaugh.

Yellow Creek gorge through Chestnut Ridge, comes next, 8½ miles north of the gorge of the Black Lick, and by it

Pine and parts of Buffington, Brush-valley, and Cherry-hill townships are drained.

Penn Run makes a ravine rather than a gorge through Chestnut Ridge, 4 miles north of Yellow Creek gorge.

Two-Lick creek makes the next gorge through Chestnut ridge 2½ miles beyond Penn run.

The south branch of the Little Mahoning gets one of its branches from a gorge through Chestnut ridge in Grant township, 6½ miles beyond (north of) Two-Lick gorge.

Finally Bear run (flowing east into Whiskey run and the Susquehanna river) cuts a channel across the axis of Chestnut Ridge within 3 miles of the northeast corner of Indiana county.

In the eastern part of the district the topography is easily separable into a succession of high anticlinal ridges separated by shallow synclinal valleys, out of which have been scoured, generally at right angles to the strike of the rocks, a number of ravines and deep narrow valleys. The rocks dip usually at low angles, excepting in the gaps through the anticlinal ridges, and the sides of the ravines and cross valleys have therefore gentle slopes, which become even more gentle when Barren rocks take the place of the Lower Productive Measures. West of Chestnut Ridge the country is more in the nature of a high rolling table land. The anticlinal axes though geologically distinct are however much more feeble and the topography is more complex, there existing apparently throughout all this western region little or no relationship between the anticlinal lines of upheaval and the present ridges of high land. The Lower Barren Measures here mainly overspread the surface which is intersected by water courses to a much greater extent than the Lower Productive country east of Chestnut Ridge, but the streams are inferior in size and the valleys less high though usually much broader than in the eastern townships. As an instance of how a valley expands under a change in the geology, the Little Mahoning creek furnishes a good illustration, starting as this stream does in Lower Productive Measures and flowing through a contracted cañon-like ravine until it finally issues into a broad, smooth

valley of Lower Barrens. Other instances of the same kind will suggest themselves to those familiar with the county.

The tables given below will suffice to inform the reader of the general elevation of the surface above the level of the sea. The Pennsylvania railroad and its branches form a continuous section line across the southern border of the county, while Mr. Barrett's surveys for the Seabord Pipe Line Company give a detailed and very complete section across the uplands of the northern townships.

The Conemaugh hills are very uniform and regular, their summits averaging from 250 to 300 feet above the bed of the river, excepting in the gaps through the mountain ridges where the slopes rise much higher. Between Nineveh and Bolivar and between Blairsville and Saltsburg the railroad is rarely more than 50 feet above the Conemaugh, so that the uplands stretching north from the river start with an elevation ranging between 1100 and 1300 feet above the ocean level. How much these figures are increased in the northern townships is admirably shown by Mr. Barrett's table of levels, in which the average elevation of the surface exclusive of the axial ridges, is shown to vary between 1200 and 1600 feet, the lower figure indicating rather the water level line in the little valleys, the average elevation of the uplands being about 1400 feet. In the Ligonier Basin the surface is rather more uniform, and on the whole somewhat higher in these northern townships than the country stretching west from Chestnut Ridge.

The increase in the general elevation of the surface from south to north is very gradual. The country is of course very much broken and diversified by small hills and valleys; but the topography nevertheless presents in substance one broad incline plane tilted gently towards the southwest, a condition, moreover, which the structure of the region has in common with the topography, so that the incline of the surface from north to south is not the result of the erosive agencies, but existed originally, ever since the uplift of this part of the Continent above the Carboniferous ocean.

The levels along the summit of Chestnut Ridge are likewise an indication of the changes which take place in the

geological structure of the mountain. This latter differs from the rest of the County, in that it is tilted toward the *northeast* as far as Two Lick Creek, whence northeastward towards Clearfield County the movement is upward along the centre of the ridge. In Indiana County the crest of the mountain is highest opposite the Packsaddle (Conemaugh River) and lowest at the gap of Two Lick. Northeast of the latter stream the levels along the crest increase steadily but the elevation attained at the Conemaugh is not regained inside the limits of the district.

2. Drainage System.

Nearly all the water draining from the surface of Indiana county flows westward into the Allegheny. Only a few square miles in the northeast corner of the district fall within the water basin of the Susquehanna leading eastward into the Atlantic ocean.

The county may be divided by the main arteries of its drainage system into four parts: The first comprehending the Conemaugh river with its intricate system of tributary streams; the second, Crooked creek draining a central zone; the third, the Mahonings in the northern part of the district; and the fourth, the affluents of the Susquehanna.

Chestnut Ridge is a divide between the waters of the east and west in Indiana County, from near Cookport in Green township northeast to the Clearfield county line. North of this the Ridge is unbroken for many miles, but south of Cookport it is cut again and again, each time to its base, thus letting out the combined waters coming from the east westward and southwestward into the valley of the Conemaugh.

The water sheds between the Conemaugh, Crooked creek, and the Mahonings are irregular belts of high land trending in an east and west direction across the county. The first of these going north crosses over from Cambria county about two miles south of Cherry Tree; runs then in an almost straight line until opposite Cookport, when it bends northwestward, and maintains this course as far north as

the "Purchase line,"* which then follows along the crest of this high land to the head waters of Dixon's Run; here the divide turns southward to run then between Crooked Creek and Two Lick (belonging to the Conemaugh system,) as far as the county seat, in which latitude it sweeps around to the west, and then passes through Armstrong township, around the head waters of Black Legs, past West Lebanon (which is built upon it,) and so on into Armstrong county.

South of this line from one end of Indiana county to the other all the waters go into the Conemaugh; north of it *but only east of Chestnut Ridge*, into the Susquehanna; but west of Chestnut Ridge and north of the line above sketched, to about the latitude of Marion, the waters belong to Crooked creek.

Crooked creek is separated from the Mahoning by a broad high plain of Lower Barrens, stretching from the headwaters of Dixon's Run in a west-northwest direction, around the town of Marion and through East and South Mahoning townships.

It is unnecessary to enumerate even the principal branches of these main arteries, inasmuch as all the important streams are plainly laid down on the map, and there show for themselves. But it may be said of them that while even the largest stream, the Conemaugh, is not navigable even for small boats, yet they furnish in the spring and autumn cheap and quick transportation for the rafts and logs from the timber districts; and they are also the source of an ample and unfailing water power at all seasons of the year.

3. Levels Above Tide.

The following list of levels, which will be found both useful and interesting, gives the elevation above mean tide Atlantic ocean, of each principal station along the line of the various Railroads, so far as these relate to Indiana county;

* This line, called Penn's Purchase Line starts at Cherry Tree corner and runs in a W. N. W. direction to Kittanning, the county seat of Armstrong; in Indiana County it forms the southern boundry of Montgomery, Grant, East Mahoning and South Mahoning townships.

the same list also includes some very valuable hyposometrical data, obtained by means of accurate section lines across various parts of the district.

Along the line of the Pennsylvania and West Pennsylvania railroads the levels are as follows:

Pennsylvania R. R.

Sang Hollow (in Laurel Hill gap)	1143
Conemaugh Furnace	1135
Nineveh	1141
New Florence	1076
Lacolle*	1056
Lockport	1054
Bolivar	1033
Blairsville Intersection	1113

West Pennsylvania R. R.

Blairsville (Market street station)	1011
Livermore	945
Saltsburg	891

The stations on the Blairsville and Indiana branch of the P. R. R. occupy the following elevations, the datum being the same as before:

R. R. Junction near Blairsville Intersection	1111
Blairsville (as above)	1011
Smith's Summit	1101
Wier's run	970
Black Lick	963
Water station	966
Black Lick bridge	1982
Doty's bridge	1011
Rugh's	1038
Saw-Mill run	1016
Bell's Mill's run	1032
Phillip's Summit	1044
Kissinger's Summit	1055
Two-Lick creek	1044
Reed's	1145
Indiana terminus (Main street)	1311

The following barometrical levels (which must be considered only as approximately correct) are here introduced to show the relative elevations of the points named. They relate entirely to the summits of the main ridges:

Summit of Laurel Hill overlooking Sang Hollow,	2300
Nolo; summit of Nolo anticlinal,	1834?
Summit of Chestnut Ridge opposite Packsaddle,	2050

* Until very recently the name of this station was Houston, and was so called in Mr. Allen's First Report of Progress.

Oaks' Point, ... 1900
Summit of Chestnut Ridge, Black Lick gap, ... 1894
Summit of Chestnut Ridge at Greenville, ... 1600
Summit of Chestnut Ridge near Smithport, ... 1815

The projected pipe line for the transportation of oil from the heart of the oil regions to the Atlantic seaboard, passes in a southeasterly direction through the northern part of the county, entering it a short distance south of Smicksburg in West Mahoning township, to continue thence across the northeast corner of South Mahoning, passing close to the Smyrna church, and so on to the town of Marion; beyond this it enters Green township in which its course is past the Dunkard Church, past Buterbaugh's mill and within about one third of a mile of Cookport; it finally crosses the Cambria County line about 6 miles S. W. of Cherry Tree.

Mr. O. Barrett, Jr., the engineer in charge of the Western division of the Pipe line, has kindly furnished the Survey with a copy of his levels through Indiana county. They show most admirably the gradual rise and fall of the surface, and need no explanation whatever:

Stations.	Elevations.	Trees, &c., Marked with White Paint.
1376.70	1481.9	In Armstrong Co. Land of J. Scott, 1½ m. from Dayton.
1377.00	. . . .	Line of Armstrong and Indiana counties.
1378.35	1474.00	6' right Chestnut Oak. On land of E. D. Sheffer. In woods.
1401.20	1489.55	46' right Cucumber Tree. Land of J. L. Buterbaugh.
1419.25	1463.35	8' left White Oak, edge of woods. Land of Sam'l T. Fulton.
1429.15	1470.00	11' right Apple Tree, in orchard, near dwelling of S. T. Fulton.
1442.90	1461.20	92' right White Oak, near Public Road. Land of J. A. Wingrone.
1453.40	1433.50	170' from Pin Oak. Smicksburg 2 miles north.
1481.90	1387.75	80' right Wild Cherry. Land of Ephraim Ritchey.
1490.75	1403.00	6' right White Oak. Land of Chris. Good.
1498.90	1305.00	35' left Poplar. " " " *Smicksburg, about* 2 miles north.
1515.50	1278.10	15' right spring house of Barnabas Lowe.
1519.00	1313.30	15' left Apple. Land of Mrs. Lena Lukehart.
1537.00	1292.00	20' left White Oak, "snag." Land of Mrs. Catharine Bowser.
1544.80	1315.95	69' right White Oak. Land of Mrs. Catharine Bowser.
1558.40	1464.50	90' left dead tree. Land of John Lewis.
1559.90	1483.50	20' left fence stake. " "
1561.30	1480.70	52' right " " " Between two pines, on high hill, very prominent point.
1570.75	1309.30	9' right fence stake, 150' right dwelling of John Lewis.
1580.80	1338.50	8' left fence stake. Land of Isaac Good. About 18 miles to Indiana and 20 miles to Kittanning from station 1580.80.

Stations.	Elevations.	Trees, &c., Marked with White Paint.
1589.95	1279.30	4' right dead tree. Land of Isaac Good.
1599.20	1350.10	19' right dead Wild Cherry. Land of David Elkin.
1604.65	1300.30	37' left dead tree. " " "
1608.90	1246.60	4' right White Oak. Edge woods. Land of Jas. M. Wells.
1613.60	1256.50	6' left Hickory. Edge woods. Land of Jas. M. Wells.
1631.65	1225.80	107' left Wild Cherry. Edge woods. Land of Jas. M. Wells.
1638.30	1237.20	50' right dead tree.
1642.80	1231.80	16' left White Oak. Beginning of Woods.
1652.05	1225.45	12' right " In Woods. Land of Robt. L. Mabon.
1665.50	1219.90	23' left White Oak. Edge of Woods. Land of J. L. Mabon.
1669.60	1221.20	138' left Hickory. Front of Mr. J. L. Mabon's dwelling.
1676.35	1228.45	35' left White Oak.
1680.65	1279.60	78' left Red Oak.
1684.20	1276.70	8' Left Maple.
1695.00	1899.30?	right of gate post, near Absalom Neff's barn.
1701.45	1216.20	15' left White Oak. Land of Absalom Neff.
1717.70	1245.90	9' right White Oak. In Public Road. Land of John Smith.
1725.45	1314.00	28' right fence stake, between house and barn of Mr. Smith.
1727.55	1313.50	32' left Ash.
1739.00	1335.70	4' right Cucumber Tree.
1745.20	1372.90	38' right Ash. Land of Allen Hamilton.
1757.20	1344.35	73' left Hickory. Land of Mrs. Hannah F. Hamilton.
1762.85	1303.60	right White Oak. *Smyrna Church* 900' north.
1776.90	1326.15	15' left Gum. Land of Silas W. Brady.
1781.50	1395.50	6' left Pin Oak. In woods. Land of W. A. Hamilton.
1785.95	1321.20	2' left fence stake. Land of Thomas Stuart.
1794.40	1316.40	21' left White Oak.
1802.35	1513.60	7' right Red Oak. Top Hill in woods.
1819.00	1294.40	55' right large White Oak. Land of James Hopkins. Near Public Road.
1847.30	1428.40	6' left fence, near dwelling of Moses T. Work.
1868.70	1277.80	15' right White Oak. In Road. Land of E. I. Work.
1881.45	1341.30	20' right Pin Oak. In Road. Land of Wm. I. Work.
1889.55	1354.10	70' left Pine. " "
1898.40	1373.10	4' right Pin Oak, in woods.
1910.90	1349.00	10' left White Oak, edge woods. Land of Mr. Steffer.
1926.00	1350.10	8' left " Land of Mr. Steffer.
1932.15	1271.40	6' left White Oak. Land of Abner Griffith.
1934.40	1280.90	1' left fence stake, in Public Road.
1950.50	1318.00	53' right Locust. Land of Wm. G. Stewart.
1970.90	1347.80	4' left Chestnut. Land of Samuel Lewis. In woods.
1984.90	1463.90	10' left Chestnut. Land of J. J. Williams. Edge woods.
1991.70	1493.90	55' right Chestnut. In field. *Marion*, ¾ mile south.
2002.60	1411.60	5' right White Oak. In woods. " "
2014.35	1534.40	3' left fence stake. In field. Land of Levi Spencer.
2018.75	1549.10	5' left Chestnut. In woods. " "
2028.30	1486.90	14' left White Oak. In clearing. Land of James Hunter.
2050.00	1666.70	8' left dead tree in field. Land of James Hunter.
2057.10	1693.70	4' right White Oak, in Public Road. Land of James Hunter.
2071.20	1627.20	11' right dead tree. Land of Samuel Lewis. 15 miles to Indiana.
2079.85	1631.70	55' right Hickory. Land of "Abe" Lowman, Jr.
2088.50	1594.30	3' left Hickory. Land of Geo. Schrader.
2100.05	1457.80	8' left Maple in Public Road.
2113.45	1471.50	5' right dead White Oak. Land of Lorenz Reithmiller.

Stations.	Elevations.	Trees, &c., Marked with White Paint.
2118.40	1470.60	9′ right Wagon Shed, near Reithmiller's buildings.
2125.75	1413.00	4′ left dead White Oak.
2140.20	1643.90	3′ left Hickory. Beginning woods.
2153.50	1458.10	9′ right Lynn, in *new* Road. Land of Solomon Fullmer. In woods.
2155.15	1424.00	15′ right Beech.
2166.25	1398.70	4′ right Beech. In woods. Land of Kinter Heirs.
2167.00	. . . .	In Public Road.
2167.95	1399.10	1′ right Maple. In woods. Land of Kinter Heirs.
2201 60	1588.10	11′ left Gum. In woods. Land of W. N. Barr.
2206.00	1647.80	left dead tree. Out of woods.
2215.60	1591.00	34′ left Cucumber Tree. On land of Mrs. Eliza Rice. Mrs. Rice's buildings to the right.
2217.25	1587.00	In Public Road. 14 miles to Indiana.
2223.60	1643.80	1′ right small dead Chestnut, Beginning woods.
2233.95	1624.10	8′ right Maple. In woods.
2240.00	1527.80	13′ right White Oak. In woods. Land of Joseph Ober.
2242.35	1515.90	6′ left small White Oak.
2250.90	1620.60	16′ right "Snag."
2256.90	1640.10	7′ left Chestnut. In woods.
* 2262.00	1628.00	46′ left dead White Oak. Out woods.
2266.75	1586.20	50′ right Stump. Land of Moses and Wm. Lydick.
2278.20	1575.20	4′ left "Big" White Pine.
2284.90	1599.40	9′ left Poplar. Beginning of woods.
2297.15	1621.60	8′ left White Pine, in Public Road on land of Jacob Fyock.
2302.25	. . . .	In cross roads. Dunkard Church close to the left.
2307.45	1643.90	15′ left White Oak. In Public Road.
2314.90	1665.10	11′ left Gum.
2333.75	1653.00	5′ right Chestnut. Land of Geo. Wise. In Public Road.
2338.55	1625.00	10′ left fence post. Solomon Wise's buildings to the right.
2354.00	1556.50	13′ left dead White Oak. Land of Mr. Mumma.
2363.75	1486.20	3′ right White Oak. Mrs. Catharine Barr's dwelling to the right.
2368.50	1446.50	11′ right Pine.
2382.50	1427.70	16′ right Apple Tree. Land of John Buterbaugh.
2393.80	1442.00	4′ right dead Pine. Mills and Dam to the right.
2405.30	1390.00	15′ left dead White Oak.
2417.50	1430.90	14′ left dead White Pine. Land of Mrs. J. H. Stumpf.
2430.35	1535.20	4′ left dead Pine in clearing. Land of Solomon Buterbaugh.
2433.45	1539.70	11′ right White Oak, near Public Road.
2450.45	1606.90	73′ left Pine "Snag."
† 2457.45	1584.80	56′ left large Maple. Land of Wm. H. Lutman.
2469.35	1581.30	16′ left White Pine. Back of Lutman's buildings.
2480.30	1576.40	4′ left Red Oak. On land of Mrs. McCullagh.
2481.75	. . . .	In Public Road, near old Planing Mill. Cookport ¼ mile to the south
2487.30	1578.00	6′ right Chestnut. Land of Richard Cook.
2498.00	1555.30	1′ right Chestnut. In woods.
2515.85	1574.70	2′ right Pine. In Public Road.
2523.10	1559.60	4′ left Pine. " "
2536.50	1549.20	3′ left Pine. " " Land of Geo. Baker.
2553.50	1614.20	11′ right Stump. " "
2559.40	1604.70	16′ right fence. " " Land of Peter Leasure.

* Chestnut Ridge.

† Ligonier Basin.

Stations.	Elevations.	Trees, &c., Marked with White Paint.
2561.75	. . . .	Peter Leasure's buildings on both sides of road.
2562.85	1580.40	15′ left Balm of Gilead. Public Road.
2572.15	1574.80	12′ right Pine. " "
2584.60	1517.80	6′ right Hemlock. " "
2589.20	. . . .	Compton's Saw Mill and Dam.
2592.30	1438.80	17′ right small Pine.
2595.45	1486.30	Right Red Oak, in woods.
2603.30	1570.50	4′ left Hemlock, "
2610.10	1512.20	6′ left " " In wood road.
2614.00	1467.90	9′ left " "
2621.95	1619.20	3′ left " "
2626.15	1638.40	20′ left Maple, near Public Road. Spruce P. O., ½ mile north. Cherry Tree 5½ miles north. Indiana 16½ miles south-west. *
2628.25	1626.70	4′ right Hemlock. In woods.
2638.30	1527.00	3′ right White Oak. "
2640.15	1510.00	Two Lick Creek at Repine's old Saw Mill.
2642.95	1528.70	9′ right Maple. Land of J. C. Repine.
2655.15	1680.10	8′ right Stump. Land of Thomas Patterson.
2661.00	. . . .	Public Road. Church to left.
2664.50	. . . .	Patterson's buildings to left.
2666.34	1671.40	4′ right Chestnut.
2676.20	1736.20	7′ right Chestnut. Land of J. C. Leasure.
2683.45	1869.10	28′ left Chestnut. In road and in woods.
2691.50	1920.30	1′ right Chestnut Oak. In woods. Land of Thomas McDowell.
2701.05	1974.80	9′ left Chestnut Oak. Land of Robert Pershing.
2705.20	1956.70	28′ right fence post.
2707.50	. . .	Pershing's buildings close to left.
2710.20	1946.60	4′ left fence stake.
2714.60	1972.20	5′ right Chestnut Oak.
2719.55	1963.30	1′ left fence stake in Public Road.
2722.90	1940.60	20′ right Hickory. Land of J. T. Thomas, Sr.
2729.00	1906.00	17′ right Chestnut. Land of O. J. Williams.
2739.65	1965.30	5′ right Chestnut Oak. Land of David Martin.
2745.55	1999.20	8′ left Stump. *High point.* Divide between Alleghany and Susquehanna waters. †
2751.00	1991.40	19′ right Stump.
2752.00	. . . .	D. Martin's buildings to right.
2762.25	1970.80	6′ right Stump. In Public Road. Martin's store to right. 18 miles to Indiana. 16 miles to Ebensburg.
2770.80	1941.90	30′ right dead Pine. Land of J. Martin.
2774.25	1905.70	8′ right Hickory. Land of Mrs. Nancy Keith.
2779.70	1848.30	2′ left Beech. Beginning of woods.
2781.65	1843.90	4′ left Beech. Land of J. Martin. In woods. On waters of Dutch Run, flowing into the Black Lick.
2786.55	1830.20	4′ right Pine. *About* the line between Indiana and Cambria Counties.
2790.65	1825.30	4′ left Hemlock.

* Ligonier Basin.

† Ridge of Nolo Anticlinal.

The whole of the stations are not given, as I thought it not necessary.

The stations run " by hundreds of feet and the decimals of a hundred feet.

Station 2790.65 would read: two hundred and seventy-nine thousand and sixty-five feet; or, 52.85 miles.

4. Soils.

Excepting in the river bottoms along the Conemaugh, the soils of Indiana County are native to the place in which they are found—formed from the slow disintegration of the rocks composing the country round about. And even in the river bottoms the material forming the soils has not been transported from any great distance, but has come from regions close at hand in which the surface rocks are similar to those in Indiana County.

Generally speaking the surface of Indiana County requires only intelligent cultivation to yield abundant and profitable returns.

The western uplands of the district, or, in other words the townships situated west of Chestnut Ridge, are mainly overspread by the rocks of the Lower Barren series, and these measures, though rarely yielding a deep soil, usually furnish one more or less productive, which however is little calculated to withstand hard usage it too frequently receives at the hands of the farmers. In order to have it preserve a fairly remunerative condition it requires constant assistance in the form of some fertilizing element, this treatment being all the more imperative in a region where attention is largely given to the cultivation of those crops that exhaust the soil and drain it of its productive elements. To counteract this ceaseless wear and tear free use should be made of the limestone existing in boundless profusion all over the county. The limestone in many places is much intermixed with impurities, yet it is always sufficiently good for agricultural purposes and where it has been utilized has yielded very satisfactory results. The region is well watered in every part, and where limestone belts extend through the fields, springs are frequent.

The surface of the country east of Chestnut Ridge in Indiana County, is less favorable to cultivation than the basins to the west. This is partly on account of the steepness of the hills in the Ligonier Basin, but is chiefly owing to the wide outspread of Lower Productive rocks, in which the amount of sandstone is proportionately greater than in the

Lower Barrens, so that the resultant soil is necessarily much more lean and cold. Besides this, the surface is frequently covered with boulders and fragments of rock which act as a great obstruction to the farmer. It should be said, however, of that part of the Ligonier Basin bordering the Conemaugh river and between this and Black Lick and even beyond for a short distance, that the uplands at the centre of the trough are composed of the same smooth Barren rocks, that prevail so largely in the western townships. Hence we find a comparatively fertile belt of land running close to the synclinal and extending as far north nearly as Yellow Creek, beyond which however lower rocks predominate, and different conditions prevail. This explains the presence of the forest and unimproved lands of the north, which when stripped of their timber, will have little value excepting for their mineral contents.

5. Forests and Timber Lands.

Within the limits of this district there exists a considerable variety of timber if we consider all the trees that grow there. But many of the varieties are only sparsely represented, while a few kinds of wood make up the bulk of the forests. These leading varieties may be enumerated in the order of their extent as follows:

1. White Oak.
2. Pine.
3. Hemlock.
4. Chestnut.

To properly classify the other kinds of wood in the order of their distribution would require a minute survey. In the following list, therefore, no attempt at classification has been made.

5. Poplar.
6. Hickory.
7. Ash.
8. Beech.
9. Rock Oak (sometimes called Chestnut Oak).
10. Wild Cherry.
11. Black Walnut.

12. Sugar Maple.
13. Locust.

What is now the agricultural section of Indiana county, namely, all those townships lying west of Chestnut Ridge (with the exception of Grant and Canoe) was originally a forest of white oak. Little by little the uplands have been cleared of their forest growth, but much of this timber is still standing, especially in the valleys, and white oak is regarded by competent judges to still remain the leading wood of the county.

Among the farmers in the region it has become a by-word that "good white oak timber land is good wheat land," which expresses in a manner the nature of the soil and the country which this wood naturally seeks. With the soft slates and shales of the Lower Barren Measures the white oak stretches to the foot of Chestnut Ridge, forming there a line along the junction of the Lower Barrens and Lower Productives.

The Sugar Maple also seems to thrive best in the low-lands and in soil resulting from the disintegration of the softer rocks. It will, however, often climb a mountain flank, if protected by the sides of a ravine in which soft slates predominate; but the maple is confessedly at home in the damp soils of creek bottoms, for it is almost invariably in such places that we find the "Sugar Camps" of Somerset county, where large quantities of maple sap are yearly boiled.

Chestnut and Rock Oak make up the greater part of the timber along the flanks and summit of Chestnut Ridge in Indiana county. The Chestnut especially seems to seek high and exposed places, or is at least indifferent to such localities.

The Pine and Hemlock occupy an elevated belt of country in the north-east corner of the county. Indeed it may be said that the anticlinal axis of Chestnut Ridge virtually marks the boundary line between these Pine and Hemlock forests, and the smoother country to the west with its white oak, poplar, walnut, &c. There is, however, one small belt of excellent timber land, containing both pine

and hemlock, in Canoe township, west of Chestnut Ridge. This is the region in which the Little Mahoning Creek takes its rise, and it is, so far as I am aware, the only occurrence of pine and hemlock west of Chestnut Ridge in Indiana county.

Another interesting fact with regard to the geographical distribution of pine in this district, is that this wood does not extend south of Yellow creek; moreover, the region in which it exists to the almost total exclusion of all other varieties, is a long broad flat, over the greater part of which the Mahoning sandstone, very massive and heavy, is only thinly concealed. About Cookport and the Pine Flats, at the heads of Twolick, there yet stands a comparatively large amount of valuable pine timber. Originally there existed much pine along Cushian and Cush creeks further to the northeast, but by far the best timber of these fields has been cut away and floated down the Susquehanna.

Hemlock abounds in the Black Lick valley among Lower Productive rocks, as it does also along the lower waters of Yellow creek and Two Lick.

A large part of the Ligonier Basin, like the rest of the county, has been cleared of its timber, and is under cultivation; but the valleys of the deeper streams, particularly where the slopes are abrupt, have been but little interfered with, and are hence often a wilderness for miles. These valleys with the flats of Green township contain the very choicest timber in the county.

Through the kindness of several gentlemen abundantly qualified to express an opinion in such matters, I am enabled to state the following figures with regard to the amount of pine and hemlock still standing in the county. It is not supposed that these figures are entirely accurate, but it is claimed that they are very near the actual truth.

Along Little Mahoning Creek, ...	25,000,000 feet
Along Two Lick and Cushian, ...	75,000,000 feet
Along Yellow Creek, ...	10,000,000 feet
Along Black Lick (Hemlock only), . . .	10,000,000 feet

6. Summary of results and mineral resources.

The work of 1877 in Indiana County, has among other things, established beyond doubt, that the rocks of the Lower Productive Coal Measures cross the great anticlinal of Laurel Hill from the First Basin without suffering any material modification or change, either as regards their total thickness or in the number of their enclosed coal beds, limestones, &c.; and further, that they continue in what for all practical purposes may be considered the same condition across the several basins to the west, as far at least as the eastern border of Armstrong County, where work will be resumed in the season of 1878, and continued thence to the Allegheny Valley, to be joined on there with the very complete work of Prof. White, extending west from the Allegheny river to the Ohio State line.

The surprising regularity of the Lower Productive group throughout the whole First Basin from the Moshannon to the Maryland line, is familiar to every reader of the Pennsylvania reports. This regularity, remarkable as it is, is no greater than prevails in the same rocks in the Second, Third and Fourth Basins. One may go all over Indiana County from the Conemaugh river to the Jefferson County line, and from Cambria to Armstrong, without experiencing any difficulty in identifying the coal beds and limestone deposits of the Lower Productive series, by the same guides that were used in operating in the First Basin.

The dominant rocks of the series as they present themselves in the First Basin, are repeated in Indiana County wherever these measures rise above water level; and here as there they are separated by very nearly the same vertical intervals, in many cases the intervals being exactly the same as in the section considered to be typical of the Lower Productive measures in the First Great Basin. From this, however, it must not be supposed that an argument favoring the absolute parallelism of the strata would be presented, because any such supposition is sufficiently disproved by the frequent local variations in the measures, displayed either by the contraction or expansion of their bulk, or by slight

modifications of the mineral character of the strata. It is, however, a fact, in whatever light it may be viewed, that the typical vertical section of the First Basin is repeated again and again in every basin of Indiana County, agreeing too in every way with the work in the same basins in Clearfield and Jefferson Counties to the north. This is sufficient to show the regularity with which these measures extend over miles and miles of territory, and while not uniformly parallel to a sufficient degree to enable us to identify coal beds in every case by means of the vertical distances separating them, yet the variations from what we may justly consider the normal condition, can never produce confusion after the entire section is worked out.

Elsewhere in this volume (Chap. IV) is discussed the relationship existing between all the rocks of the Lower Productive series, so that the subject may be dismissed here in a few words. One of the chief points of interest in the Indiana County Survey, was the tracing westward of the now famous Johnstown Cement bed,—the rock that, for so long a time, was wrongly associated with the classical Ferriferous limestone of the Allegheny Valley. The non-identity of these two strata was sufficiently pointed out and proved in the Report of Progress for 1876*, and the subject requires no further elaboration. As regards the character and thickness of the rock in Indiana county, the reader must be referred to the detailed chapters of the volume, in which every locality where the stratum was observed is noted. But it may here be said that this limestone band continues in an unbroken sheet westward across all the anticlinal and synclinal flexures of the strata to re-appear occasionally but in a very attenuated form in Mr. White's sections.

The geological horizon of the true ferriferous limestone is so seldom above water-level west of Chestnut Ridge in Indiana county, and where it rises above the drainage line it has been so infrequently exposed by the farmers that it would be inexpedient to attempt to define its true relationship to the lower part of the group because the sections in this region of country are necessarily imperfect. But its

* Chap. XVIII, Report HHH.

relationship with regard to the upper strata of the Lower Productive group, has been very clearly made out, and found to agree closely with the conditions prevailing in the Allegheny Valley.

The position of the Ferriferous limestone as regards the lower strata of the group, may at the present writing fairly be regarded as uncertain. Some of the sections obtained in Indiana County would indicate that this limestone strata occupies a position between what we have regarded in these reports as A and B coals, and there is no reason to doubt the entire correctness of these sections. Such a construction, though it would explain many facts observed in the First Basin, would nevertheless be in conflict with what for years has been held as the correct position of the Ferriferous limestone in the column of the Lower Productive measures. As elsewhere intimated the facts at hand are insufficient to reverse the opinion formed long ago by able and competent geologists; but it must at least be regarded as an open question and one that will be decided by the Survey of Armstrong County.

Excepting in the case of the Upper and Lower Freeport beds, all *names* of coals have been carefully omitted from this report; in their place capital letters are used, the same lettering that was employed all through the First Basin.

In the Chapter of the Somerset county report already referred to, it was shown that the *triple form* of the Freeport group,—a classification adopted at the beginning of the present Survey, could not be maintained, and that to prevent inevitable confusion in the future, it was necessary to return to the original classification of the Freeport coals into two beds,—the Upper and Lower Freeport. This has been done in the present report, the name *Middle Freeport* disappearing from the list. The same bed is now called the Lower Freeport, but retains its letter of the First Basin, namely D′. The Lower Freeport of the First Basin reports, goes for the present without a name, being known only by the letter D. It is the Darlington coal of Mr. White's sections, and throughout Indiana County as well as in the

southern part of the First Basin it comes into the measures directly above the Johnstown cement bed.

In the following schedule is shown the relative position occupied by the principal strata of the Lower Productive series, together with the classification and lettering adopted for the coal beds in this report. It will be observed that the Ferriferous limestone appears underneath coal bed C, between this and bed B, where it is at present supposed to belong.

For purposes of comparison the schedule used in the First Basin reports is placed side by side with that employed in the present volume.

Indiana County.	First Basin.
Upper Freeport coal (E).	Upper Freeport coal (E).
Freeport limestone.	Freeport limestone.
Lower Freeport coal (D′).	Middle Freeport coal (D′).
Lower Freeport limestone.	Middle Freeport limestone.
Freeport sandstone.	Freeport sandstone.
Coal bed D.	Lower Freeport coal (D).
Johnstown cement bed.	Johnstown cement bed.
Coal bed C.	Kittanning coal (C).
Ferriferous limestone.	Absent.
Coal bed B′.	Coal bed B′.
Coal bed B.	Clarion coal (B).
Coal bed A′.	Coal bed A′.
Sandstone.	Sandstone.
Coal bed A.	Brookville coal (A).

The survey of the Lower Barren rocks in Indiana county, yielded very few reliable sections. One of the best and most important, was obtained at Dilltown on Black-Lick creek in the Ligonier Basin; this section extends without a break from the Upper Freeport Coal to the Morgantown Sandstone, and although not complete in all its details, yet it shows many interesting features which resemble closely those observed in the same rocks in Somerset county. If to this Dilltown section be added the measures observed at Blairsville between the Morgantown Sandstone and Pittsburg Coal, the Barren Measure column will be complete, so far as its length is concerned.

The Western uplands of the county, though largely covered by Lower Barren rocks, contribute very little to our

knowledge of the geology of these measures. In studying them the same difficulties were encountered that have been met with by every geologist operating in these rocks in the western part of the State, namely, meagre exposures embracing only a few feet of rocks, and separated by wide horizontal intervals. Under such circumstances to build up a column of measures, it is necessary to supply numerous missing links to the chain, and in these gaps it frequently happens that we pass over the only recognized horizons of the group, so that our section teaches us nothing. The very nature of these strata causes them in weathering to conceal their basset edges, and excepting for the limestone deposits enclosed in them they offer no inducement to the farmer to explore them. In the natural exposures only the harder strata of the group are exposed, the small coal beds being generally concealed beneath a mass of soft crumbling shale.

But certain members of the series have already been recognized as steadfast, and as constituting reliable horizons. These were repeatedly identified at such parts of the county as include them; but the coals and limestones of the Berlin group though likely present in some recognizable form, could not always be satisfactorily established.

The thickness of the group varies but little, maintaining an average of about 600 feet. These are its dimensions at Blairsville, and also at Saltsburg, the only points in the county where the entire series can be measured.

The best known and most widely recognized members of the series are the following, omitting for the most part the coals of the Berlin group:*

The Little Pittsburg Coal.
The Little Pittsburg Limestone.
The Connellsville Sandstone.
The Morgantown Sandstone.
The Elk Lick Coal.
The Green or Crinoidal Limestone.
The Black fossiliferous Limestone.

* For the generalized section of the Berlin group, see Report HHH, Chap. IV.

The Philson coal.
The Philson limestone.
The Gallitzin Coal.
The Mahoning Sandstone.

Mineral resources.

The colored geological map accompanying this Report shows distinctly the areas covered by Productive and non-Productive rocks, and renders unnecessary any extended verbal description. The detailed chapters of the volume explain at length the nature and character of the mineral resources of the county; where these have been explored; how they are situated in the hills; in what direction and if possible at what angles they incline, together with such other information as may be of interest in regard to them.

Excepting the small patches of Upper Productive Measures at Blairsville and Saltsburg, the Lower Productive group are the only rocks that can be depended upon for coal in Indiana County; and by reference to the geological map it will be seen at a glance that west of Chestnut Ridge these measures are chiefly below the present water line of the streams. They therefore underlie the whole of the western uplands, and to reach them at many points would require deep shafts, but fortunately for this part of the county such a necessity is avoided by sufficient coal having been raised at a few localities above water level for a short distance by the anticlinal axes. Cheap fuel therefore, while not everywhere obtainable in the western townships, is easily accessible from almost any point.

In the Ligonier Basin, (east of Chestnut Ridge) the greater part of the area is occupied by Lower Productive rocks, and coal therefore abounds in that section in prodigious quantites. Many hillsides contain for a long distance the entire Lower Productive group with all its enclosed coal beds, limestones, &c. Some day these vast stores of fuel will be needed for the arts and manufactures, but not until other fields equally large and more favorably located have been exhausted, and that day is yet far distant.

The amount of available limestone in the county is no less great than the coal, while its distribution is wider and much more even, for layers of this valuable rock are intercalated not only in the Lower Productive group, but in the Barren series as well. Its use as a fertilizer of the soil does not seem yet to be fully appreciated in all parts of the county, and its too sparing use will account in large part for the unsatisfactory results frequently obtained by the farmers in tilling the land. Here and there, however, the advantages arising from its utilization are understood by the farmers, whose fields present then a striking contrast to those barren strips of country, in which the soil, though made up of the same material, is exhausted from overwork and lack of proper treatment.

The iron ores of the county have never been systematically investigated. As far however as the present indications and exposures go, there is probably very little workable ore in the district. "Balls" and "nodules" of carbonate iron ore, sometimes of great size, are found in nearly every considerable stratum of shale, but such deposits have no practical interest and may therefore be left out of consideration in summing up the mineral resources of the county. The only deposit of iron ore worth speaking of, was observed on Yellow creek, but this is insufficient of itself to supply the needs of even a small furnace.

The clays of the district include not only some excellent varieties of fire clay, but also some valuable surface deposits, from which good bricks for building purposes have been made.

The fire clays although existing in great abundance in all parts of the county, have as yet been developed only along the lines of railroad communication. At these points the clays worked are of excellent quality, the bricks and retorts made from them being well and favorably known.

The compact and heavy bedded sandstones prevailing in some parts of the county furnish building material almost without limit. This rock has been employed to a small extent with very satisfactory results. By consulting the index and the detailed chapters of the Report, the reader

will find at what localities the sandstones are especially available for building purposes.

The question of the petroleum interests of Indiana county, although deeply affecting its citizens, is one with which this report is not concerned, having only to deal with the coal rocks. But in view of the excitement that prevailed in many parts of the district during the past season, in regard to the probabilities of finding petroleum at certain specified points, it may be said of the wells as yet put down within the limits of Indiana County that having failed in every case by many hundreds of feet to reach the oil bearing sands of Venango and Butler Counties, they leave the petroleum question as undecided in Indiana county as it was before the holes were drilled.* It can probably with safety be predicted that if oil exists in available quantities and at reasonable depths underneath Indiana county, it is held by the same rocks that furnish it in such great abundance in the counties to the west and north-west. The rocks thus indicated are the so called Oil Sands, the nearest approach of which to the surface in Indiana County is in the heart of the Conemaugh gaps through Laurel Hill and Chestnut Ridge. At both these places the First Oil Sand, the highest member of the group is not more than 500 feet below water level, whereas at the centre of the basin at Blairsville, the same rock is scarcely less than 2000 feet below the bed of the Conemaugh. Whether it would be reasonable to expect to find oil on the backs of the great anticlinal arches of Laurel Hill and Chestnut Ridge is a question foreign to the purpose of the present discussion. The centres of the basins have mainly been selected for such imperfect tests as have hitherto been made in this region.

Natural gas escapes at the surface, but only in very lim-

*Recently a well was started at the Deep Hollow, at the centre of the Indiana anticlinal, two miles below Blairsville. It is the intention of those persons engaged in the enterprise to continue the drilling until the Oil Sand group has been pierced. This will be a complete test, so far as this particular spot is concerned, and should furnish a valuable record of the thickness of the rocks. Where the hole starts the Upper Freeport Coal is about 100 feet beneath the river bed so that likely the First Oil Sand will be met at a depth of about 1500 below water level. At the present writing the well is nearly 1000 feet deep, but the record could not be obtained for publication.

ited quantities, at several places in Indiana county. Perhaps the best known of these localities is the "Burning Spring," at the Deep Hollow two miles below Blairsville. Moreover it is stated with regard to this place that a thin film of petroleum is frequently observed on the surface of the river which flows close by. Both the gas and the oil in this case issue from the Mahoning Sandrock, a part of which is exposed in the high bluffs skirting the river bank, while nearly one hundred feet of the same massive depoit is here below water level. The manifestations have therefore no bearing upon the oil question in a commercial sense, and do not as many have falsely supposed, give evidence of a favorable condition of the deeper Oil Sands at this particular place. What the condition of these sands may be underneath Indiana County and at any part of it, no one can say until the drill has pierced them; but with the aid of the vertical sections in this volume and the systematic description of every part of the region, a close calculation may easily be made of the vertical distance from the surface of almost any farm to the oil sands beneath it.

In the subjoined table are grouped all the chemical analyses made by Mr. McCreath from specimens sent to him from Indiana county. The specimens were in every case selected by myself with a view of representing as nearly as possible the average condition of the deposit at the point exposed. The analyses relate chiefly to the coals, and the show made by these is on the whole rather unfavorable. It is however entirely possible that the same coal beds in other parts of the county may be far less impure, so that these analyses must be understood as representing the condition of the seams only at the points indicated, and not as applying generally to the beds over the entire district.

It will be observed that the coal analyses have been arranged in the order of the respective basins in which they belong, following thus the general plan of the Report, which treats of each Basin separately. But the analyses have been arranged in this manner more especially with a view of bringing into greater prominence the gradual increase in the amount of hydro-carbon gases going westward, a fact

long ago known and discussed. The law of this increase however has not yet been satisfactorily worked out, and here it is interesting to note that there is almost in every case a greater difference, between the general average of the gasseous matter in the *same coal* in any two basins, than between any two parts of the same trough. This fact of course is less apparent if we discard all other constituents of the coal, but the hydro-carbons and the carbon, and then consider the proportion that the first of these bears to the second. But such for the present purpose is not a correct test, because the Fixed Carbon found by deduction, will always vary with the purity of the coal, or in other words, will rise or fall independently of the gaseous matter, according to the percentages of sulphur and ash.

The gradual increase going west, in the amount of hydrocarbon gases in the coals, was explained many years ago by Prof. H. D. Rogers as due to the gradual decrease in the disturbance of the strata in the same direction. But very recently this theory has been disputed by Prof. Stevenson* who attributes the change in composition to a corresponding and equally gradual change in the *structure* of the bed, thus implying that the action of heat had less to do in transforming and converting the coals into what we now find them, than the varied conditions under which the bed was formed. This expression will of course include the difference in the vegetation from which the coal arose, and it must be said that only by this theory can be explained the analyses of the three sub-divisions of the Upper Freeport coal at Lockport, where the middle bench contains much less volatile matter than either of the layers above and below it.

* See Report KK, p. 62.

Analyses of Coals in Indiana County.

Table I.—The Ligonier Basin. (Second Basin.)

	Water.	Volatile matter.	Fixed carbon.	Sulphur.	Ash.
1. D. Harris, Lockport, Bed E, Upper bench,	.600	24.467	71.900	.588	2.385
2. D. Harris, Lockport, Bed E, Lower bench,	.450	24.215	60.947	1.173	13.215
3. P. Kindport, Cherry Tree, Bed E, } *	.880	24.630	68.333	1.227	4.930
4. Luly mine, Cherry Tree, Bed D′ (?), }	.800	24.635	72.436	.559	1.570

* Report HH.

Table II.—The Blairsville Basin. (Third Basin.)

	Water.	Volatile matter.	Fixed carbon.	Sulphur.	Ash.
5. T. Sloan, Blairsville, Pittsburg bed,	.850	27.385	49.748	3.017	19.000
6. R. Smith, Blairsville, Pittsburg bed,	1.130	28.895	56.409	2.571	10.995
7. G. M. Doty, Blairsville, Pittsburg bed,	1.370	29.130	58.461	.849	10.190
8. W. Snyder, Blairsville, Bed E,	.770	27.800	67.537	.718	3.175
9. H. Ragar, Blairsville, Bed E,	.600	26.531	61.525	.629	10.715
10. E. J. Meldren, Bell's Mills, Bed A,	.560	27.880	61.920	3.610	6.030
11. Indiana Coal Co., Homer, Bed B,	.920	24.356	62.218	4.916	7.590
12. Indiana Coal Co., Homer, Bed E,	.800	25.770	70.224	.621	2.585
13. D. B. Griffiths, Homer, Bed E, Upper bench,	.590	28.710	52.488	5.462	12.750
14. D. B. Griffiths, Homer, Bed E, Lower bench,	.700	29.800	63.766	1.719	4.135
15. D. Walker, Gettysburg, Bed D, Upper bench,	1.270	28.930	60.175	.950	8.675
16. D. Walker, Gettysburg, Bed D, Lower bench,	1.240	29.630	65.172	.503	3.455
17. S. L. Lowry, Decker's Pt., Bed D, Upper bench,	.880	23.375	50.324	.621	24.800
18. S. L. Lowry, Decker's Pt., Bed D, Middle bench,	.870	24.485	52.964	.621	21.060
19. S. L. Lowry, Decker's Pt., Bed D, Lower bench,	1.320	30.320	66.083	.654	1.623

Table III.—The Marion sub-basin. (*Fourth Basin, 1st sub-division.*)

	Water.	Volatile matter.	Fixed carbon.	Sulphur.	Ash.
20. S. Waddle, Kelly's Station, Bed E,	1.220	33.570	59.689	2.151	4.370
21. S. C. Hazlett, Jacksonville, Bed E,	1.180	26.500	56.679	.671	14.970
22. J. Forsythe, Jacksonville, Bed D,[1]	1.010	28.505	55.380	.700	14.405
23. Groft Bros., Chambersville, Bed E,	.950	31.420	55.215	1.215	11.200
24. J. Brady, Marion, Bed D,[1]	.920	31.320	57.266	2.669	7.825
25. J. Beatty, Marion, Bed E,	.990	31.760	52.190	4.625	10.435
26. N. Jeffries, Richmond, Bed D,	.860	31.535	59.093	3.162	5.350

Table IV.—The Saltsburg sub-basin. (*Fourth Basin, 2d sub-division.*)

	Water.	Volatile matter.	Fixed carbon.	Sulphur	Ash.
27. J. L. Ashbaugh, Clarksburg, Pittsburg bed,	1.110	37.555	53.639	1.436	6.260
28. J. Evans, West Lebanon, Pittsburg bed,	1.460	31.995	53.783	.997	11.760
29. J. Evans, West Lebanon, Pittsburg bed,	1.040	36.940	50.850	1.465	9.705
30. R. R. George, West Lebanon, Pittsburg bed,	1.680	34.975	57.000	.665	5.680
31. D. Marlin, Five Points, Bed E, ?	1.100	31.890	60.736	1.279	4.995

Table V.—Analyses of Limestones.

	Carbonate Lime.	Carbonate Magnesia.	Oxide Iron and Alumina.	Sulphur.	Phosphorus.	Insoluble residue.
1. J. Livengood, Blairsville,	54.768	8.627	6.930	.112	.107	27.230
2. P. Brown, Blairsville,	82.321	8.021	2.630	.102	.017	5.502
3. R. Smith, Blairsville,	79.821	3.601	3.020	.117	.018	12.160
4. G. M. Doty, Blairsville,	65.892	9.636	5.710	.292	.016	16.540
5. Fyhawk, Bell's Mills,	78.768	2.421	3.540	.097	.018	13.970
6. D. Griffiths, Homer,	72.264	6.493	4.190	.068	.029	14.980
7. S. Palmer, Decker's Pt.,	88.232	1.371	1.960	.048	.017	8.210
8. T. Gorman, Smithport,	58.750	16.005	7.390	.041	.085	15.060
9. T. Gorman, Smithport,	*36.214	16.883	†4.360	.056	.056	32.790
10. Simpson, Richmond,	92.857	1.589	2.030	.187	.035	2.090
11. Groft Bros. Chambersville,	84.407	2.800	2.120	.188	.018	9.150
12. S. C. Hazlett, Jacksonville,	89.821	1.801	1.700	.133	.027	5.430
13. A. H. Fulton, West Lebanon,	82.768	2.875	2.830	.156	.011	10.327
14. Wining & Cuisin, Kelly's Station,	91.982	1.664	1.520	.091	.012	4.105
15. Rev. Mr. Brown, Five Points,	84.125	5.198	3.220	.073	.014	6.021

* Carbonate of iron, 8.078. † Oxide of alumina only.

Table VI.—Analyses of Ironstones.

	Metallic Iron.	Carbonate Iron.	Carbonate Lime.	Carbonate Magnesia.	Alumina.	Sulphur.	Phosphorus.	Insoluble residue.
1. D. Griffith, Homer,	28.600	59.278	16.607	7.113	3.273	.066	.051	11.600
2. Carpenter, Five Points,	*	22.992	25.839	3.344	7.183	.010	.201	38.220

* Not determined.

Table VII.—Analyses of Fire-Clays.

	Silica.	Alumina.	Protoxide Iron.	Titanic Acid.	Lime.	Magnesia.	Alkalies.	Water, &c.,
1. E. Robinson, Bolivar, (Hard clay,)	50.840	30.745	3.213	1.260	.160	.288	.541	13.050
2. E. Robinson, Bolivar, (Plastic clay,)	59.830	24.580	1.655	1.170	.280	.872	3.114	7.830
3. E. J. Meldren, Bell's Mills, (Hard clay,)	64.830	23.950	.900	.880	.110	.187	.296	9.390
4. E. J. Meldren, Bell's Mills, (Plastic clay,)	68.490	18.460	1.566	2.150	.230	.551	2.755	6.310

CHAPTER II.

The Geological Structure of the District.

The geological structure of the district is one of extreme simplicity. Briefly stated, it consists of a series of seven anticlinal and six synclinal folds of the strata, or broad rock waves, the crest lines of which run nearly parallel to each other across the map in a northeast-southwest direction through the county. The rocks therefore dip northwest and southeast, except in places where the anticlinals and synclinals are sufficiently tilted along their central line to affect the normal incline of the strata. If then we start in the extreme southeast corner of the county, say about a mile above the old Conemaugh Furnace, and proceed in a straight line northwest to where the Jefferson and Armstrong county lines join in the northwest corner of West Mahoning township, we shall cross the following anticlinal and synclinal axes :

The Laurel Hill Anticlinal. (First Axis of the old Survey.)
The Centreville Synclinal. } Ligonier Basin.
The Nolo Anticlinal. }
The Mechanicsburg Synclinal. }
The Chestnut Ridge Anticlinal. (Second Axis of the old Survey.)
The Blairsville Synclinal.
The Indiana Anticlinal. (Third Axis of the old Survey.)
The Marion-Fillmore Synclinal.
The Saltsburg Anticlinal. } Westmoreland gas coal basin.
The West Lebanon Synclinal. }
The Perrysville Anticlinal. }
The Smicksburg Synclinal. }
The Roaring run-Port Barnet Anticlinal. (Fourth Axis.)

In way of explanation of those names in the list that are new to the reader of the Pennsylvania reports, it may be said that most of them apply only to this county, and are intro-

duced simply for convenience of description. The Nolo anticlinal, for example, is a small subaxis splitting the Ligonier basin lengthwise, and attaining its greatest development inside the limits of this district, beyond which it is scarcely known. So also with the synclinals, (the Mechanicsburg and Centreville synclinals) on both sides of the axis; to the south, as well as to the north these are united into one great trough (by the disappearance of the anticlinal,) and pass under the well known name of the Ligonier Synclinal. Moreover the Marion-Fillmore synclinal is only the prolongation into Indiana County of Prof. Stevenson's Greensburg synclinal, and the West Lebanon synclinal is the Lisbon synclinal of the south. Both of these axes, the Greensburg-Marion and the Lisbon-West-Lebanon merge before reaching the Sandy Lick creek in Clearfield County into one trough—the Reynoldsville; whereas the Smicksburg synclinal, the same that crosses the Sandy Lick near Fuller's mills, is forced eastward, going south by the disappearance of the Perrysville anticlinal, and probably joins on somewhere to the Lisbon-West-Lebanon axis.

The Third Axis, as it was named many years ago by Messrs. Hodge and Lesley in their early survey of the northern Counties, was described by Prof. Stevenson in his Report of 1876 as the Blairsville anticlinal; but the name of this town is already occupied, and properly for the synclinal, and as the county seat of *Indiana* is the only town of importance under which this axis runs, it furnishes the anticlinal with a more appropriate geographical name, if any such be desired. The name Perrysville, (from the village of Perrysville in Jefferson County,) is suggested for the second subaxis of the Fourth Basin, an axis hitherto unnamed, and the one that crosses the Little Mahoning above Smicksburg, and the Sandy Lick two miles west of Reynoldsville.

With two exceptions, the rocks which make up the surface of Indiana County belong to the Carboniferous system. The exceptions noted are in the deep gaps of the Conemaugh through Laurel Hill and Chestnut Ridge anticlinals, where for a short distance a few feet of Devonian strata are lifted above the drainage line.

The Lower Barren and Lower Productive groups of the Carboniferous rocks are those with which we have mainly to deal in Indiana county. These measures are brought up again and again by the anticlinals and spread over miles of territory. At two places in the county a small portion of the higher Upper Productive group is represented in the hills, these places being the regions between Blairsville and Black Lick, and Saltsburg and West Lebanon.

In the following scheme of the formations is a list of the rock groups that underlie the highest *geological* ground of the district, as for instance at Blairsville, for a distance of ten miles; and it likewise includes at its top some two thousand feet of measures that at one time overspread this whole region, but which have been slowly swept from it in the course of time and carried downwards by the streams into the sea. The same scheme has already been given a number of times in these reports, and is again reproduced to make this volume complete in itself. With regard to the minor sub-divisions of such of the rock groups as cover the surface of Indiana county the reader has only to consult the index and the detailed chapters of the volume to find out not only what are the dominant rocks of each series, but their thickness, character, and position in the geological scale.

I. The Carboniferous System.

1. *Monongahela river coal series.*

Upper Barren measures,
a. Greene county group,
b. Washington county group,
} Absent in Indiana county.

Upper Productive coal measures; present only in part.

2. *Allegheny river coal series.*

Lower Barren measures.

Lower Productive coal measures.

Pottsville conglomerate (Seral). XII

c. Sharon and Quinnimont coal group.

Mauch Chunk red shale, ... }
Mountain limestone, ... } XI
d. New river coal group, ... }

Pocono sandstone (Vespertine) (Mountain sands). X

II. *The Devonian System.*

1. Catskill sandstone (Old red) (? Oil sand group). IX
2. Chemung sands and shales, ... } VIII.
3. Portage shales and sands, ... }
4. Hamilton formation, ... }
   Genesee black shales, ... }
   Hamilton sandstone, ... }
   Juniata river coal group, ... }
   Marcellus black shales, ... }
5. Upper Helderberg limestones, ... }
6. Oriskany sandstone, ... VII

III. *The Silurian System.*

1. Lower Helderberg limestone, ... VI
   Salina, Niagara, &c.
2. Clinton red shales and fossil ore, ... V
3. Medina sandstone, ... } IV
4. Oneida conglomerate, ... }

IV. *The Siluro-Cambrian System.*

1. Hudson river slates, ... } III
2. Utica slates, ... }
3. Trenton limestone, ... } II.
4. Magnesian limestone, ... }
   Chazy, Calciferous, &c., ... }
5. Potsdam sandstone, ... I.

V. The Cambrian System (South mountain).

VI. The Huronian System (Philadelphia rocks).

VII. The Laurentian System (Highlands).

PART II.

THE LIGONIER BASIN IN INDIANA COUNTY.

Chapter III.

The General Features of the Basin together with a description of the Chestnut Ridge and Nolo Anticlinals.

The Ligonier Valley is a long straight trough stretching in a northeast-southwest direction. It is enclosed on the northwest and southeast by the twin anticlinal mountains of Laurel Hill and Chestnut Ridge, which in Fayette and Westmoreland counties tower a thousand feet above the bed of the valley, making it there, topographically, the best defined basin in the Bituminous Coal region of Pennsylvania. But in the prolongation of the valley north and east of the Conemaugh through Indiana and Cambria counties, this topographical distinctness of outline is nearly obliterated, partly by the depression of the enclosing mountains, and partly by the uplift of the centre of the valley, which before crossing the Clearfield county border, is little more than a broad elevated plain, twenty miles wide, intersected and diversified by numerous deep valleys and ravines.

The uplift of the valley is due to a subordinate anticlinal fold running along the centre of the Basin and gaining rapidly in strength towards the northeast. This I have called the *Nolo axis*, from the village of Nolo, under which the anticlinal passes in Pine township.

As might readily be supposed the subaxis exercises a

most important influence on the economic value of the Basin; and it has moreover the effect of changing the geological structure of the valley from a simple synclinal extending from mountain to mountain, as in Fayette and Westmoreland counties south of the Conemaugh, to a double synclinal north of the river. Going north from the river both of these sub-basins become steadily shallower in consequence of the gradual upward movement of the rocks. The course of the *Nolo anticlinal* through the eastern townships of the district is minutely described further on in this chapter.

Although no longer strictly a valley north of the river, yet the name "Ligonier" is retained for that part of the Basin treated of in this Report because the sides of the trough, Laurel Hill and Chestnut Ridge, are continuous far to the north, and are *geologically* quite as distinct in Indiana and Cambria counties as they are in the region to the south of the river. The apparent obscurity of the ridges in Indiana and Cambria counties is therefore not due especially to the weakness of the axes, but to the change which takes place in the topography of the ridges and of the whole valley after crossing the Conemaugh river. Hence the well known name of "Ligonier" familiar to all Pennsylvania geologists, may appropriately be retained for the Basin as far north as the axes of Laurel Hill and Chestnut Ridge can be recognized.

The eastern boundary line of Indiana county, at its southern end, starts on the crest of Laurel Hill. This it follows for a short distance, but finally takes a more northerly course than the mountain, thus leaving the axis to strike diagonally through Cambria county. Between the Conemaugh river therefore and the Clearfield county border, the Ligonier Basin is cut lengthwise by this eastern boundary line into two parts, one of which parts falls within the limits of Cambria county,* while the other part belongs to Indiana.

* For a detailed description of the Cambria County portion of the Ligonier Basin, see Part III of the Report of Progress HH.

The *Laurel Hill anticlinal* has been traced from the Maryland State line northeastward to the West Branch of the Susquehanna river in Clearfield county, and its geology already fully described in previous reports of this Survey. Its geology however in Cambria county is so intimately connected with the district under discussion, and is so especially related to the geology of Chestnut Ridge in Indiana county, that some of its most prominent features may here appropriately be recalled.

Where the Conemaugh river breaks through Laurel Hill below Johnstown the mountain is about five miles broad; its summit is roughly 1200 feet above the channel of the stream, or about 2300 feet above tide level; its flanks on both sides have a moderate slope, and are of regular outline, although frequently cut by short ravines heading at the crest of the mountain.

The anticlinal is perfectly symmetrical, with its centre running through the heart of the mountain. It lifts Devonian rocks (Catskill group No. IX) above the bed of the river, and is crowned at the summit of the mountain by the *Pottsville Conglomerate*, No. XII; the *Coal Measures* are therefore entirely swept from the crest of the ridge at this place, but appear lower down on each flank.

Advancing northeast into Cambria county the anticlinal steadily declines along its central line. Accompanying this geological change is a slight depression of the summit of the mountain, but the depression which takes place is not sufficient to compensate for the fall of the axis, and the Conglomerate, the top rock at the Conemaugh gap, slowly sinks under the surface going northeast, thus causing the Coal Measures gradully to rise higher on the flanks until a thin covering of these rocks ultimately sweeps across the anticlinal arch. Such is the condition of the mountain at the Black Lick gap. At Carrolltown, still further north, the entire Lower Productive coal group covers the ridge, which in that latitude is very little elevated above the surrounding country, and is scarcely distinguishable by the topography; but beyond Carrolltown the downward course of the axis ceases, and a *rise* in the same direction sets in.

This slowly pushes the Coal Measures from the crest of the ridge, thus bringing the *Pottsville Conglomerate* of No. XII, again to daylight and repeating to a considerable extent the topographical features prevailing in the region of the Conemaugh.

The Chestnut Ridge is in every respect a companion mountain to Laurel Hill. In height and general appearance there is scarcely any difference; in structure and constituent rocks they are identical; their lines of strike and the direction and force of the dips along their flanks correspond; in topographical outline they are broadly speaking the same; and what is still more noteworthy Chestnut Ridge in Indiana County undergoes precisely the same modifications and geological changes that Laurel Hill does in Cambria County. How similar then in every respect must have been the forces that lifted these mountains, and how remarkably even and regular the erosion that has since taken place along the summits and flanks of both ridges.

The *anticlinal of Chestnut Ridge* runs along the centre of the mountain, which rests upon a base from three to five miles wide. As will be seen by the map the axis is not exactly a straight line in Indiana County, but shifts its course near the Yellow Creek gap from N. 20° E. to about N. 33° E.; from this point on the latter course is maintained and carried into Clearfield County.

The anticlinal enters Indiana County at the centre of the Packsaddle gap (Conemaugh river,) and traverses thence the western border of West Wheatfield township to reappear in the deep gap of Black Lick, five miles northeast of the river. Next it crosses Yellow Creek in the northwest corner of Brush Valley township, and then runs diagonally across Cherry Hill township, being there twice deeply cut, first by Penn Run near Greenville, and again by the Two Lick below Mitchell's Mills. Northeast of Two Lick the continuity of the ridge is not again broken in Indiana County, and the mountain, though much flattened, acts as a high divide between the waters of the Ohio and Susquehanna through the northeast tier of townships. The axis passes close to Taylorsville in Green township, and

nearly under the village of Smithport, in Banks township, to run thence across the headwaters of Bear Run in the extreme northeast corner of the district. It enters Clearfield County in Bell township.

From the Conemaugh river to Two Lick Creek *the Chestnut Ridge anticlinal* sinks steadily along its strike; while from Two Lick Creek northeastward to Clearfield County, and far beyond, the anticlinal rises again, thus repeating the geology of Laurel Hill in Cambria County. The rapid flattening of dips accompanying the decline, and their subsequent sharpening as the axis rises, together with the consequent well marked and important changes in the surface geology of the crest are all described in the detailed chapters of this volume, and need not further be dwelt upon here. The general geological effect of the fall in the anticlinal is plainly shown by the geological map accompanying this volume, and the extent of the downward plunge can readily be measured by a comparison of the vertical sections constructed in the gaps of the larger streams through the ridge. Some allowance must of course be made for the difference of level above tide water of the various stream beds; but this difference is slight, and does not amount to more than two hundred feet in the two gaps widest asunder, and is certainly not more than one half this amount between one gap and that next beyond.

The vertical sections show the geology so plainly that very little verbal description is necessary. Attention may however be directed to the fact that the decline in the axis is far more rapid between the Conemaugh river and Black Lick creek than it is north of the latter stream. More than one half of the rocks which make up the high precipitous sides of the Packsaddle gorge are below the bed of Black Lick at the centre of the anticlinal, whereas a comparison of the Black Lick and Yellow creek sections shows that in a distance nearly twice as great as in the former instance the difference is less than half; and comparing Yellow creek with Two Lick there is scarcely any difference noticeable in the depth of the sections. Northeast of Two Lick as above stated, the rocks are directed

upwards along the centre of the axis, and if the ridge were cut to its base in the northeast corner of the county we should there see rocks that are not at present exposed above water-level in any of the Chestnut Ridge gaps north of Black Lick.

The average dip of the rocks along the strike of the anticlinal between the Conemaugh and Black Lick is a trifle more than 1°. This is shown by a very simple calculation, for if we allow one hundred feet (and this is the maximum) for the difference of level between the two stream beds, there still remains a difference of nearly six hundred feet in the geological depth of the two sections. In an air line distance of less than five miles, this shows a fall of over 100 feet to the mile for each particular stratum, or a dip of about 1°. This structure explains the presence at the Black Lick gap of the whole group of Lower Productive Coal Measures, of which there is not a vestige on the top of the ridge at the centre of the anticlinal at the Packsaddle; and if the summit of the ridge at Black Lick were of equal height with the summit at Packsaddle, not only the Lower Productive coals would be in the hills at Black Lick, but as much as two hundred feet of the Lower Barrens besides.

At the Packsaddle the top of the ridge is still in great part a wilderness in consequence of the sterility of the soil; but at Black Lick the country is chiefly cleared of timber and divided into farms. It is, however both rough and forbidding on account of the abundance of sandstone in the Lower Productive Coal Measures.

The roughness of the soil disappears almost entirely in the Yellow Creek region, where the *Lower Barren Measures* are the country rock; and the same soft argillaceous measures, weathering down into a smooth productive soil, run along the crest of the ridge through a portion of Cherry Hill township. But they quickly disappear from the summit as soon as the axis begins to rise to the northeast, a rise which not only forces the Lower Barren rocks from the mountain top but which also causes the outcrop of the *Upper Freeport* coal bed to slip down from the summit on

both sides, thus making the *Lower Productive Measures* again the country rock along the crest of the ridge through Grant, Montgomery and Banks townships.

In this condition the axis runs into Bell township of Clearfield county. There also the northeast rise of the anticlinal continues to prevail until at the north end of Bell township, the *Pottsville Conglomerate* at the base of the *Lower Productive Coals*, is uncovered along the axial line. Nor does the rise of the anticlinal stop even here. It is this same axis of Chestnut Ridge that "elevates Chemung rocks (No. VIII) in the bed of the Sinnemahoning at the mouths of its three principal branches, Bennett's, Driftwood, and East Branch. It then traverses the wilderness upland of south Potter county, and issues thence east of Pine creek to make the broad valley of Wellsborough and Mansfield in Tioga county, north of the Blossburg coal basin. Then it spreads out the Chemung formation (No. VIII) over all northern Bradford; crosses the North Branch of the Susquehanna at Athens, and keeps on through the southern counties of New York towards Albany."*

The Nolo anticlinal, the sub-anticlinal axis of the Ligonier Basin, is not so distinct topographically as either Laurel Hill or Chestnut Ridge. But it makes nevertheless a narrow belt of upland, recognizable by the eye as a line of hills stretching in a northeast–southwest direction. Looking east from either Mechanicsburg or Greenville these hills are unmistakable; they form the Nolo Ridge of Pine township, and they are the highlands skirting the eastern border of Brush Valley township; but still further south, across Black Lick creek, the axis runs under a broad plateau and is scarcely distinguishable by the topography.

How far this axis extends towards the northeast is not now known; it certainly passes outside the limits of Indiana County, but at the west branch of the Susquehanna river it is clearly weakening, and it likely dies out altogether somewhere in Clearfield county. On the other hand, the southwest limit of the Nolo anticlinal is positively in West-

* Report H, p. 13.

moreland county, south of the Conemaugh river, the anticlinal becoming more and more feeble in that direction as it approaches its end and expiring finally on the flank of Chestnut Ridge. Hence the axis attains its greatest strength inside the limits of Indiana county.

As the axis weakens the basin deepens, and *vice versa*. This explains the presence of the Pittsburg coal bed in the high land at Ligonier, and explains also why not a vestige of this valuable seam is found in the river hills, nor at any other point in this basin north of the Conemaugh. The detailed chapters of this report show how the depth of the basin, especially at the anticlinal, is constantly reduced going northeast, until finally the Lower Productive rocks are concealed only by a thin covering along the summit of the axial ridge.

The Nolo anticlinal crosses the Conemaugh river and enters the southeast corner of Indiana county at Lockport, being in that locality a gentle and almost imperceptible roll in the rocks. It makes itself known however in sustaining Lower Productive measures longer above water-level on the Conemaugh than the rather sharp southeast dip prevailing at Bolivar would otherwise allow.

Though the *Lower Productive* coals are in part above the river bed at Lockport, yet the axis there carries on its top a considerable amount of Lower Barren rocks. In the same condition it runs through West Wheatfield township, passing about two miles west of Armagh, and nearly under the village of New Washington, to reappear greatly strengthened on Black Lick, crossing this stream about midway between Dilltown and the mouth of Brush creek. Here it lifts the *Pottsville Conglomerate* (XII) to daylight; it also holds the *Upper Freeport* coal above water level going east along Black Lick as far as Dilltown; and it makes the hills at Heshbon coal bearing to their tops.

Next it runs through the southeast corner of Brush Valley township, to suffer a deflection, however, before entering Buffington township. By this deflection its course is changed from N. 25° E. to N. 45° E., accompanied by a corresponding variation in the dips, which moreover grow

steadily sharper as shown in the gap of Little Yellow creek. This latter stream the axis crosses above Suncliff village, having, however, first crossed Laurel Run in a gap nearly as deep as that of Little Yellow creek.

Thence it passes nearly three miles west of Strongstown, giving to this section of country a large area of workable coal beds above water level. It crosses the pike at Nolo, to run then lengthwise through Pine township; next it cuts the southeast corner of Green township and finally crosses the West Branch of the Susquehanna at a point about one mile above the town of Cherry Tree.

The surface geology of the region through which the Nolo anticlinal passes, undergoes constant change owing to the steady rise of the axis to the northeast. These changes consist wholly in a gradual reduction of the thickness of the Barren Measure covering that everywhere caps the axis in Indiana county. The land is universally smooth and good along the summit of the ridge, but it is there barren of productive coal beds. Workable seams of coal belonging to the Lower Productive group are, however, found close at hand, above water level, in the gaps of all the principal streams through the ridge, and along the upper waters of Little Yellow creek stretching to the northeast corner of Pine township.

For agricultural and grazing purposes the southern townships of the Ligonier Basin offer as many and as great attractions to the farmer as any other portion of the county, the soil being the product of the disintegration of the same rocks that have made the smooth glade land to the west of Chestnut Ridge. This part of the basin is therefore a fertile region, well watered and productive. But in the northeast corner of the county the case is different, the Chestnut Ridge occupying that quarter, and spreading out there a broad plain of Lower Productive rocks, of which heavy sandstones make up a considerable part. These rocks have covered a large part of Banks and Montgomery townships, with a poor lean soil that has rendered inevitable the present wilderness condition of the region.



Chapter IV.

A cross section of the Ligonier Basin along the line of the Conemaugh river.

The Conemaugh river cuts transversely across the Ligonier Valley, exposing a natural geological section embracing nearly two thousand feet of rocks. The highest member of this long column is near the top of the Lower Barren group (far up in the coal measure system,) while the base of the section is in Devonian strata. A short distance south of the river, in Westmoreland County, a slight increase in the depth of the basin brings into a narrow ridge of hills extending along the synclinal axis, a small portion of the Upper Productive coal measures overlying the Lower Barrens; but owing to causes already explained these upper coals are forced into the air before reaching the Conemaugh country, and they do not therefore properly form a part of the river section.

The section as exposed along the line of the Pennsylvania Railroad consists of the following rock formations, either in whole or in part:

1. The Lower Barren Measures.
2. The Lower Productive Coal Measures.
3. The Pottsville Conglomerate (XII.)
4. The Mauch Chunk Red Shale (XI.)
5. The Pocono Sandstone (X.)
6. The Catskill group (IX.)

All of these formations possess certain well known and easily recognized lithological characteristics that serve to individualize each group and enable the lines of demarcation, (at all events in the district now under discussion) to

be narrowly and closely drawn independently of the fossils which the rocks enclose.

Formation IX for example (corresponding to the Catskill group of the New York geologists) consists here, so far as it is exposed, largely of clay and clay marls alternating with thin bands of sandstone; these rocks highly ferruginous and chiefly of a bright red color are at once distinguishable from the obliquely bedded greenish sandstones of X, with which the reddish marls join on directly. *No. X, the Pocono Sandstone*, is a compact mass of siliceous rocks several hundred feet thick. These extend up to the *Great Carboniferous* or *Mountain limestone*, the base the next higher formation, namely, the *Mauch Chunk Red shale*, the name of which alone sufficiently describes in brief the nature of the rocks of which this group is composed. *No. XII, the Pottsville Conglomerate*, is another compact siliceous deposit as its name also implies, while the *Lower Productive Coal Measures* are a series of coals, clays, limestones, sandstones, and slates, the group beginning at the top of the *Conglomerate* and ending at the base of the *Mahoning Sandstone. The Lower Barrens*, overlying the Lower Productive Coal Measures, are marked negatively by an absence of workable coal beds, but are better known by certain well marked and persistent horizons.

The lines of demarcation between these several Formations could not possibly be more plainly drawn than they are along the Conemaugh river in the Ligonier Valley; and no more handsome display of the rocks could be desired than is there furnished by the abundance of natural exposures and the frequent side cuttings of the Pennsylvania railroad skirting the right bank of the river. With the Conglomerate and sub-conglomerate rocks, however, this Report in general can have little to do, because these measures are very infrequently exposed in Indiana county, the prevailing surface rocks belonging either to the Lower Barrens or to the Lower Productive coal group.

The Conemaugh outcrops of Formations XII, XI, X and IX as they here appear are of especial importance from the fact that west of Chestnut Ridge, these measures are con-

cealed in southwestern Pennsylvania beneath a thick covering of Coal Measure rocks. Below a brief sketch is given of the condition and thickness of the above named Formations in the eastern part of the State, in order that the changes they undergo may be more fully appreciated.

No more striking fact results from a comparison of these rock groups in Eastern and Western Pennsylvania than the rapid abatement of bulk shown to take place in all of the lower formations, traveling westward. The full thickness of For. IX is not known on the Conemaugh ; but No. X is reduced to about one third of its thickness on Pocono Mountain in Eastern Pennsylvania ; XI is here shrunk to about one fifteenth of its thickness at Mauch Chunk, while No. XII is reduced from more than one thousand feet thick at Pottsville, to less than one hundred feet thick at Bolivar.

With regard to the Lower Productive Coal Measures, the comparison can at present be intelligently carried only as far east as Broad Top Mountain in Huntingdon County. East of this not only great lithological changes occur in the group, but the section otherwise is so dissimilar from that in Western Pennsylvania, that if any resemblance exist at all between them, it is so faint that identifications of the intercalated coal beds are nearly impossible. But comparing the Lower Productive Coal Measures of Broad Top with the same rocks as they appear in the western part of the State, we find so great a similarity existing between the sections, that the coals, bed for bed, may without difficulty be recognized at both places. Moreover these rocks do not share in the gradual feathering process, by which the lower measures are so greatly affected ; on the contrary if there is any change at all in the aggregate thickness of the Lower Productive Coal rocks, the increase in bulk is westward, accompanied by a gradual accumulation of calcareous matter.

The general results may then thus be summarized, leaving details for subsequent pages :

1. Slight increase in thickness of L. P. C. M. towards W. & N. W.
2. Increase in thickness of limestone deposits " " "
3. Decrease " " " " Pottsville Conglomerate " "
4. " " " " M. Chunk Red Shale " "
5. " " " " Pocono Sandstone " "
6. " " " " Catskill rocks " "

Besides these changes occur also many minor modifications of a lithological character, that affect the general result but little; these have only a local bearing, having arisen from conditions that prevailed over a limited territory.

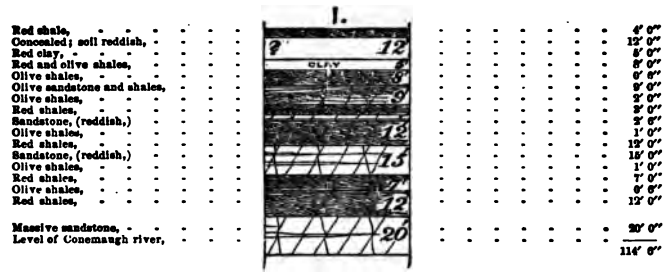
Formation IX; Catskill Rocks.

It was stated above that the Catskill rocks are only partially exposed along the Conemaugh river. In the gaps of Laurel Hill and Chestnut Ridge only about two hundred feet of these measures are above water level; while north of the river in Indiana county Formation IX does not again rise above the stream beds, but extends in an unbroken sheet far below the general surface of the country. Even in the deep gap of Black Lick, and in the almost equally deep gorges of Yellow creek and Two-Lick through Chestnut Ridge, the arch of the Catskill rocks across the anticlinal is several hundred feet below the channels of those creeks.

What little of For. IX is exposed along the Conemaugh, can best be seen at the centre of the Laurel Hill anticlinal below Johnstown. Its oval shaped outcrop area extends only a short distance in either direction from the axis, owing to the rather sharp northwest and southeast dips which there prevail. But the frequent exposures at the heart of the gap show how the red clays of IX extend up to and touch the greenish sands of X.

The section here in detail is as follows:*

*Report HH, p. 95.



Formation IX, the Ponent of Prof. Rogers' classification, is the equivalent of the Old Red sandstone. It has an extensive outspread in New York State, forming there the greater part of the Catskill mountains, from whence it has derived its geographical name. Prof. Hall describes it as consisting in the latter locality of alternating strata "of sandstone, shale, and shaly sandstone, conglomerates and impure limestones." Moreover, these strata in the Catskills, like their equivalents in Pennsylvania, are much stained with ferruginous matter, the pervading color of the sandy parts being, according to Prof. Hall, a brick red.

In Eastern Pennsylvania, where Formation IX passes under the Anthracite coal fields, it has a composition similar to that above described, and a thickness of nearly 2,000 feet, which is likewise its dimensions on the south flank of the Catskills. In the Broad Top region of Huntingdon county it has increased in bulk to 2,680 feet, which is also its thickness on the face of the Allegheny Mountain. Its thickness under the Ligonier basin in Indiana county is not known, because only the upper members of the Formation are above the level of the Conemaugh; but the oil well now being drilled at Blairsville will show the character and thickness of the Catskill rocks in that region.

The topography of For. IX is eminently characteristic, rising either as a high, uneven terrace on the flanks of the mountains of X as at the mouth of the Juniata, or cut up by numerous ravines and projecting then as bold spurs as along the Allegheny mountain overlooking Tyrone, Altoona and Hollidaysburg.

These rocks seldom contain any stratum of economical

importance. They constitute, however, most undoubtedly the so-called "Big Red" of the Venango and Butler oil wells, but what relationship the true oil sands of the latter region bear to the Catskill formation, is not yet definitely settled.

Formation X, Pocono Sandstone.

The greenish sands and grits of the Pocono sandstone (the Vespertine of Rogers) have a wide geographical range in Pennsylvania, forming as they do the south-east border of the Bituminous coal fields. The same formation also encloses the anthracite basins, having there a thickness of nearly 2,000 feet and forming the Pocono mountain, from whence comes the geographical name assigned to the Formation by Prof. Lesley. It has even a greater thickness where measured by Mr. Ashburner on Broad Top showing there nearly 2,200 feet from top to base; but in the great leap from the Broad Top to the Allegheny it loses more than one-half its rocks and appears on the mountain face above Altoona as a formation only about 1,000 feet thick.

Thence westward and northwestward the reduction is continuous but more gradual. In the Conemaugh gap of Laurel Hill the entire thickness of the formation does not exceed 650 feet;* in the Packsaddle gorge (Chestnut Ridge) east of Blairsville it is about the same; then it passes under the uplands of Westmoreland and Indiana, and where "it rises again in Ohio and Northern Pennsylvania from its underground journey [it is] so lean and changed as scarcely to be recognized. It is there a formation of greenish sandstone less than two hundred feet thick. The whole intermediate space of course it underlies; that is all Northern and Western Pennsylvania, all Western Virginia and the whole southern region of the Cumberland mountain; here it is as thin as in the Catskill region,† but here as there helps to pile up the immense plateau, which narrowing as we go southward domineers with its lofty terminal crags the plains of Alabama." ‡

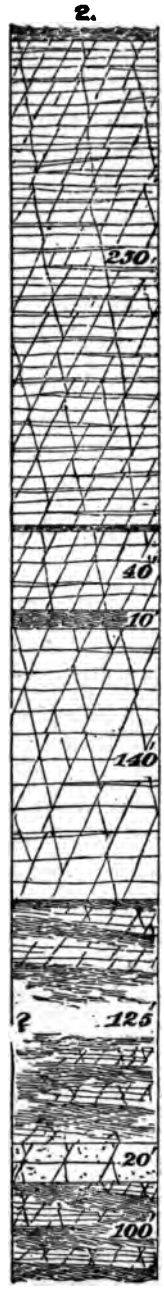
* Final Report V. II, p. 468.
† Between 150 and 200 feet thick.
‡ J. P. Lesley: Manual of Coal, p. 63.

Prof. Fontaine has made a careful study of the outcrops of the Pocono sandstone in West Virginia, and in his published descriptions of it* shows that the maximum thickness of the formation in that locality does not exceed one thousand feet, and this is including about 500 feet of rocks which Prof. Fontaine thinks may belong to the Catskill group.

In the Packsaddle gap (Chestnut Ridge) the exposures of X along the left bank are very complete, showing the following section:

* Silliman's Journal, January and February, 1877.

No. X Pocono Sandstone.



Sandstone, greenish, flaggy,	250′ 0″
Shale, sandy,	8′ 0″
Argillaceous sandstone,	40′ 0″
Argillaceous shale,	10′ 0″
Sandstone,	140′ 0″
Interval; all shales and sandstone,	125′ 0″
Sandstone, heavy bedded conglomerate,	20′ 0″
Sandstone and shale,	100′ 0″
	688′ 0″

In the Broad Top region the group is divisible into three members, *the upper member* being described by Mr. Ashburner as consisting "of coarse grained, massive, brownish-gray and gray sandstone, alternating with thinly bedded and flaggy sandstones of the same color."* The thickness of these rocks is about six hundred feet.

The middle member of the series consisting largely of sandstone contains however some interstratified beds of coal which belong to the *New River coal series*, thus corresponding in geological position to the coal seams discovered many years ago by Prof. Lesley in Montgomery and Wythe counties, Virginia. These beds at Broad Top range from one inch to three inches in thickness; in many cases they rest upon a floor of fire clay, but are rarely roofed otherwise than by hard compact sandstone. They are devoid of all economical importance on Broad Top, but expand into workable beds in Virginia.

The lower member of X on Broad Top is chiefly composed of sandstone, either of a green, yellow or olive color.

Though much reduced in thickness on the face of the Allegheny Mountain the lithological features of the group are there very similar to those above sketched. In describing its condition along the escarpment of the latter mountain, Prof. Rogers states that "the Vespertine sandstone, no longer possessing the coarseness of a conglomerate, is an argillo-siliceous group of strata, consisting of white, gray and yellowish sandstones, with interstratified beds of dark shale and slate. Some of the shales resemble very closely in color and composition those of the true coal measures, and they embrace occasional layers of dark carbonaceous slate, not unlike that which covers many coal seams. They are generally destitute, however, of the characteristic vegetable fossils, and nowhere present us with beds of genuine coal."†

None of the carbonated slates and shales here described occur in the Packsaddle section, unless they appear in the interval of 125 feet near the base of the column. And while

*Measured Section of the Palæozoic Formation of Western Pennsylvania.
† Final Report, Vol. II, p. 467.

this is not only possible, but extremely likely, yet the question admits of some doubt.

As far, however, as the formation is exposed on the Conemaugh river, there does not seem to be a vestige either of coal or coal slates. It consists of a mass of sandstone, partly obliquely bedded, and partly massive and compact. The rocks are chiefly of a greenish cast and fine grained, but are occasionally streaked with thin bands of coarse pebbly conglomerate, made up of smooth rounded quartzite fragments of variable size and held together only loosely in a matrix of almost pure silica. The thickness of the Formation, as before stated, is between 600 and 700 feet.

In character, composition and dimension, it is therefore very similar to Mr. Ashburner's *upper member* of Broad Top; and all things considered the inference that the middle and lower members of Mr. Ashburner's section have dropped from the group before reaching the Conemaugh gaps, is not at all unreasonable.

Further west, *in Butler and Venango counties*, the Pocono sandstone has been repeatedly pierced in the numerous oil wells of that region. The connection between *Formation X* and the so-called "*Mountain sands*" of the Allegheny river region is not yet complete, but there is now little doubt that the two deposits represent a single geological horizon: in other words, they correspond and are the same.

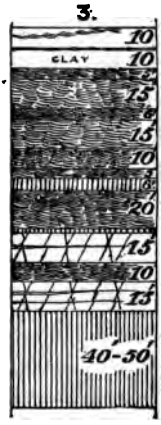
From these rocks also is derived the salt water that is the basis of a small industry at and below the town of Saltsburg, on the Conemaugh river. These wells are elsewhere described in this Report.

Formation XI, Mauch Chunk Red Shale.

Far greater than in either of the Formations above described, is the reduction which takes place in the thickness of the Mauch Chunk Red Shale, going west and north-west across the State.

Where fully developed in Eastern Pennsylvania, as for instance, at Mauch Chunk (whence its name) it is a vast accumulation of soft ferruginous mud rocks 3,000 feet

thick. This is likewise its condition and dimensions in the valleys of the Schuylkill and Susquehanna rivers; but on Broad Top we find it only 1,100 feet thick, and but 400 feet thick on the southeast front of the Allegheny Mountain, dropping then to less than 200 feet in the Packsaddle Gap, and finally to less than 100 feet in the Allegheny river region. Its character under the Ligonier Basin is best displayed by the following section, constructed from exposures below Bolivar, in the Packsaddle Gap, and verified by the additional exposures of the same formation, in the Conemaugh gap of Laurel Hill, on the eastern side of the basin. The section, without a break from the heavy sandstone of XII, to the current bedded sands of X, is as follows, reading downwards:



Reddish Clay shale,	10′ 0″
Sandy iron ore,	0′ 8″
Clays, variegated,	10′ 0″
Red shale,	5′ 0″
Variegated shales,	15′ 0″
Red shale,	6′ 0″
Ferruginous br'n shales,	15′ 0″
Green sandy shales,	10′ 0″
Red shales,	5′ 0″
Dark argil. limestone, fossiliferous,	0′ 0″
Variegated shales,	20′ 0″
Limestone impure,	2′ 0″
Sandstone,	15′ 0″
Red shales,	10′ 0″
Sandstone,	15′ 0″
Siliceous (Mountain) Limestone,	40′ 0″—50′ 0″
	194′ 8″

It may here be stated that in the Conemaugh gaps of Chestnut Ridge and Laurel Hill, there are no transition rocks whatever between Formations XI and XII, the red shales of the lower formation being there in direct contact with the lowest member of the *Pottsville Conglomerate.* This is very handsomely shown in a side cut along the railroad below the village of Bolivar.

Nor is the base of XI any less distinct, either in the Packsaddle gap, or in the gorge of Laurel Hill. At both these places the grits of X begin directly underneath the *Carboniferous* or *Mountain Limestone*, and the base of that great

stratum is here, without doubt, the base of formation XI. That this is a considerable change from the condition of the formation further east, need hardly be said; for it is well known that not only along the face of the Allegheny Mountain, but as far east as Broad Top, the *Mauch Chunk Red Shale* is divisible into three distinct groups, of which the *Mountain Limestone* is the middle member, the lower member of the group in those places consisting of a mass of red shale and sand, which, however, steadily thins (going west) from Broad Top, and finally disappears altogether from the Formation before reaching the Ligonier Basin of Indiana county, leaving the *Mountain Limestone* to rest there upon the upper member of X.

Formation XI, in the eastern part of the State, consists chiefly of a series of soft shaly mud rocks highly iron stained and of a bright red color. Its character is very uniform throughout the Anthracite region, showing there a great deficiency of calcareous matter; these same conditions prevail generally throughout all the northern end of the Bituminous Coal field, but "tracing the formation southwest along the eastern escarpment of the Allegheny Mountain, and in the several anticlinals to the west of this, in Somerset, Westmoreland and Fayette Counties, it gradually assumes a type more removed from that of the Anthracite region. The chief portion of the mass consists of the characteristic soft red clay shale; but it includes a large portion of blue, greenish, and yellowish shale or marl and a less amount of intercalated sandstone that belongs to the stratum further north. It contains also a less abundant share of iron ore; but the feature which specially distinguishes it in this district is the calcareous matter, the quantity of which gradually augmenting, becomes very conspicuous, under the form of a distinct limestone stratum as we approach the south side of the State. The limestone shows itself near the base of the formation, appearing in the more E. outcrops, namely, near the Broad Top Basin, and in Somerset county, in the form of a very thin but continuous stratum, enlarging gradually but regularly in its extension west and southwest, until, upon the confines of Pennsylvania and Virginia, it assumes

the magnitude of a sub-formation. In this calcareous member of the Umbral series of our State, we may recognize the nearly vanished marginal portion of one of the thickest and most extensive of all the Appalachian strata of the States to the south-west and west of us. It is nothing else than the nearly exhausted edge of the great Carboniferous or Umbral limestone of Virginia, Tennessee, Alabama, Kentucky, Indiana, Illinois, Missouri, and regions still more remote, in many of which districts this rock is the principal or only Umbral formation.*

Mountain Limestone.— From the series of thin bands into which the Mountain Limestone is divided on Broad Top, the deposit has changed on the Allegheny Mountain to a compact mass of very arenaceous limestone thirty feet thick. In the Conemaugh gaps this thickness is increased to upwards of forty feet, passing under the Indiana county upland to the west of Chestnut Ridge, as a highly siliceous limestone, which is further characterized by its oblique planes of deposition. In this condition it appears at both ends of the Laurel Hill gap and again at both ends of the Packsaddle gorge, being quite extensively quarried by the Pennsylvania Railroad Co. and broken for ballast, for which purpose it is well adapted, being easily raised and slow to disintegrate. It is further exposed at the heart of the Black Lick gap of Chestnut Ridge, forming there at the centre of the anticlinal, abrupt high cliffs along the waters edge; elsewhere in Indiana county it is not known being at all other points far below the drainage lines.

The deposit continues to gain slowly in bulk towards the west and southwest, and in Kentucky it appears as a sub-formation one hundred feet thick, enclosing a vast and complicated series of caverns, of which the famous Mammoth Cave with its two hundred miles of subterranean chambers is one. Moreover, in Kentucky, as in other equally favored regions, it is intersected by numerous metalliferous lodes, some of which are of considerable value.

The limestone, however, holds no such lodes in Pennsyl-

* Roger's Final Report, Vol. II., p. 469.

vania, but in our State frequently carries on its top a deposit of carbonate iron ore, which often expands into a bed of workable dimensions, and sometimes appears sub-divided into a number of small layers. This is the case on Dunbar Creek, in Fayette county, where the ore bands have been quite extensively developed and with considerable success, the supply of ore being abundant and of good quality.* Along with this ore is usually associated, in Western Pennsylvania, a small bed of coal, which in certain parts (as on Dunbar Creek,) we find developed into a complete system of small coal seams alternating with the ore bands.

But all this, with the single exception of a small and worthless stratum of sandy ore, is absent from the formation underneath Indiana county, if we may judge from the exposures in the Conemaugh gaps of the great anticlinals. And we find there only a trace left of the rich fossiliferous limestone layers that accompany the Formation on the Youghiogheny river further south.†

Formation XII, Pottsville Conglomerate.

The Great Conglomerate or *Millstone Grit* is so greatly reduced from its thickness in the east, or even on Broad Top and the Allegheny Mountain, that it is no longer a dominant rock in the Ligonier Basin of Indiana county. But even though attenuated and often of a shaly structure, it is however invariably recognisable wherever it is above water level, and its recognition is always of importance as a starting point for the exploitation of the coal rocks of which the Conglomerate is the floor or base.

Where exposed on the Schuylkill river at Pottsville,

* At Ralston, also in Lycoming county, the iron ore deposit at the top of XI is of considerable economical importance.

† These limestone bands are handsomely displayed along the face of a steep hillside skirting the right bank of Dunbar Creek, a short distance above the Furnace. They are there a rich field for fine fossil casts, and during a recent professional visit to this region, I obtained specimens of the following species:

Athyris subquadrata H, Chester group.
Spirifer Leidyi, N. and P.
Spirifer Keokuk, Var. H.
Productus cora var pileiforniss, Chester group.
Productus elegans, Chester group.

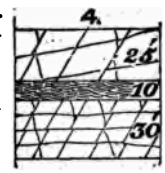
Formation XII has a thickness of 1000 feet, and is yet thicker on the Kanawha river in West Virginia. Thinning rapidly west and northwest we find it has shrunk to 280 feet on Broad Top, to 200 feet on the Allegheny Mountain, to 65 feet at Bolivar (Packsaddle gap) and finally to about 30 feet where recently pierced by the drill in an oil well on Beaver Run in Westmoreland County.

Formation XII has very little outcrop area in Indiana county. It rises however, above the beds of all the streams flowing across the anticlinal of Chestnut Ridge, but it quickly passes again beneath the drainage line to be concealed under a thick mass of Coal Measure rocks.

It emerges above the Conemaugh at Dornac Point below Johnstown preparatory to its making the long ascent of Laurel Hill and returns again to the water at Conemaugh Furnace; then it reappears below Bolivar, to run up the slopes of Packsaddle gap; it crowns the top of the Ridge on the north bank of the river and descends again at an easy dip to finally pass under the Conemaugh above Blairsville Intersection at the western entrance of the gorge. In the same manner it may be traced in the Black Lick Valley, and again on Yellow Creek and Two Lick; frequent mention is made of the Formation in subsequent chapters to which the reader must be referred for particulars.

The section as exposed below Bolivar is as follows:

Sandstone, massive, obliquely bedded; Piedmont S. S., ...	25′ 0″	
Shales, ...	10′ 0″	
Sandstone, heavy, compact, ...	30′ 0″	
	65′ 0′	



Formation XII in the Ligonier Basin of Indiana County is not strictly a *conglomerate deposit;* it is here chiefly a fine grained sandstone, that sometimes but very rarely shows belts of coarse sand and small pebbles. This is not the case on the Schuylkill river, nor is it so in the Broad Top region in both of which places its name properly describes its lithological character. It would appear that the loss of the con-

glomerate feature accompanies the reduction of its bulk, the Formation growing thinner and less coarse towards the northwest.

Throughout the west and northwest the *Pottsville Conglomerate* usually appears as a triple formation consisting of two compact sandstone layers separated by a mass of shale. The upper of these sands has been called the *Piedmont* from its great development and conspicuousness at the latter place in the Cumberland Coal Basin. The lower of the bands is the *Conglomerate proper*, the intervening shale mass being supposed to represent, but of course in a very attenuated form, the horizon of Prof. Fontaine's *Inter-conglomerate* or *Kanawha river coal series.* But in the above section of the Conglomerate, it will be observed that all trace of this coal series is gone, and with its disappearance is a reduction in the thickness of the shale mass to ten feet.

Considering the extent of the horizontal intervals between the various outcrops of the Conglomerate, it is impossible to prove the entire correctness of this identification; but the resemblance is nevertheless suggestive in spite of the enormous reduction in the thickness of the Formation, and so long as a resemblance can be recognized the names should undoubtedly be retained.

There is however no lack of evidence in Western Pennsylvania of an inter-conglomerate coal series: Bennington, Mineral Point, and the names of a score of other places in the First Basin, at once suggest themselves as instances of where such a series is developed. It has been conclusively proved that the series has also a representative on Broad Top, Mr. Ashburner's section showing that the upper and lower members of the Formation, namely, the *Piedmont* and the *Conglomerate proper*, have very nearly the same dimensions on Broad Top that they have along the Kanawha, the vast expansion of the Formation being confined to its middle member—or the coal bearing strata.

It may here be stated that from the record of the Beaver Run oil boring (above alluded to) it would seem that this middle member of XII ultimately thins out and disappears altogether from the measures, the Piedmont and Conglom-

erate proper then merging into one mass. This however is somewhat conjectural because of the incompleteness of the boring record. The drill showed that the rock is there salt bearing, and a trace of oil seems also to have been met with. Further south "on Dunkard Creek in Greene county, and on the Ohio River opposite Smith's Ferry in Beaver County"* the same rock carries petroleum in considerable quantity.

From the compactness of the deposit and the system of its cleavage planes, the rock in weathering breaks into huge cubes that often show the full height of the sandstone stratum; often again, especially where the measures are horizontal or nearly so, the Conglomerate lines the cliffs and slopes with low vertical walls of rock stretching sometimes for hundred of yards.

The Lower Productive Coal Measures.

The Conemaugh section of this group of rocks possesses all the main features of the Lower Productive Coal Measures as developed throughout the Ligonier Basin of Indiana County, and being a more complete section than can at present be obtained north of the River, it may serve as a typical column of these rocks in the Ligonier Valley or Second Great Basin. Using this section as a standard of measurement, the following pages will show what changes and modifications it undergoes along Black Lick, Yellow Creek and other streams draining the northern prolongation of the Valley; but it will be seen that these changes, though often affecting local interests, are yet slight and that they are in no instance of such a nature as to render the section unrecognizable or to deprive it of any of its main members. This is a very important fact and one of great practical interest, inasmuch as farmers and other property holders are enabled by means of the typical vertical section to explore their lands without difficulty.

It may further be said of the Ligonier Basin section, that it is virtually but a reproduction of the First Basin section, and not only with respect to the principal coal seams, and

*Report K, Second Geological Survey.

the dominant limestones and sandstones of the series, but the aggregate thickness of the rocks is about the same, whether we regard them at Bolivar at the eastern base of Chestnut Ridge, or at Bennington on the top of the Allegheny Mountain. Hence the vertical intervals or distances between any two points of the section (as for instance two coal beds) are in the Second Basin simply a repetition of what was found to prevail with remarkable constancy all over the First Basin from the Moshannon to the Maryland State line.

Finally it is proper to state, that the Conemaugh section given in detail below, agrees essentially, with the section made in Ligonier Valley, along the South Fork of Black Lick in Cambria County, and reproduced in the Report of Progress for 1875. That section, though necessarily incomplete, was yet sufficient to show that little difficulty would be experienced in reconciling the First and Second Great Basins. The work of 1877 has it is believed conclusively proved that the relationship existing between the two great troughs, separated by the wide anticlinal arch of Laurel Hill, is as intimate as the relationship existing between any two parts of the same Basin.

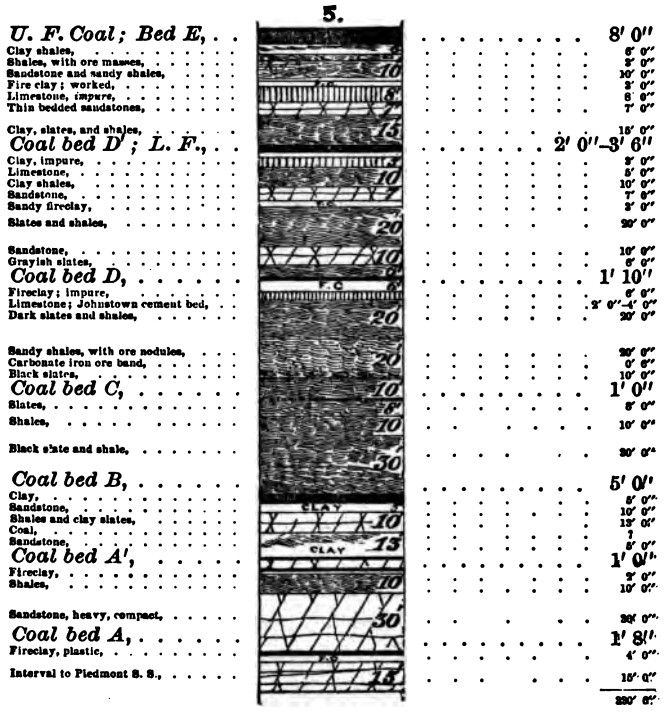
In the following brief analysis of the section, only the important members of the group are discussed, and then only with relationship to the Ligonier basin of Indiana county. It is shown, however, that the strata often possess the characteristic features by which they are marked in the First Basin.

Fire Clay under Coal A.—The first stratum of economical importance, considering the section in ascending order, is the fire clay band on which *coal bed A* rests. At Bolivar, where it has been developed, it is of a plastic nature, and is largely employed in brick making. The same stratum re-appears on Black Lick Creek, (see Black Lick section,) being there, however, rather more impure than at Bolivar.* It is one of the most persistent and widely distributed

*This fire clay band must not be confounded with the *hard* fireclay used in the brick works at Bells Mills on Black Lick; the latter seam is 20 feet lower in the measures, and is not recognizable in the exposures at Bolivar.

members of the Lower Productive group, and is everywhere in the Bituminous regions an unfailing accompaniment of Bed A, though often too impure to be utilized for fire bricks.

Beginning with the Upper Freeport coal bed as the top of the Lower Productive Coal Measures, the Conemaugh section, mainly constructed from outcrops at Lockport and Bolivar, reads as follows:



Coal Bed A.—Throughout the First Basin this seam of coal is generally very impure, from the large amount of iron pyrites associated with it. The same remark will also apply not only to the Ligonier Valley in Indiana county, but equally well to the whole county, so far as the bed has there been developed.

It varies greatly in thickness on the Conemaugh river, between Laurel Hill and Chestnut Ridge, diminishing from

four feet thick at Old Conemaugh Furnace to about 18 inches thick at Bolivar; between these two points, about ten miles apart in a direct line, the coal is far beneath the present channel of the river.

Where opened *on Black Lick Creek* as at Heshbon and Bells Mills (at which latter place it is used for steam purposes and for baking fire brick clay) it is between three and four feet thick, but at both the localities named the coal from this bed contains iron pyrites in very damaging quantities. *On Yellow Creek* the bed is reported as having a thickness of six feet. It has never been definitely ascertained what its condition is on *Two Lick Creek*, and north of the last named stream it is not above water level in Ligonier Valley, inside the limits of Indiana county.

Comparing these statements with the minor details of the bed given in subsequent chapters of this Report, it is evident that Bed A must be regarded as a treacherous and unreliable member of the group as well in point of size as of character, and that before estimating the economic value of any part of the Basin underlaid by it, it is necessary that an especially careful study of the seam should be made.

Sandstone between Coals A and B.—Overlying Bed A is a mass of sandstone so thick and usually so heavy that it might readily be mistaken (especially on Black Lick Creek) for a part of the *Conglomerate of XII*, being not only thicker in places than either band of the Conglomerate, but often much coarser grained and more compact. To consider this sandstone however as a part of the Conglomerate, even though such an arrangement would show a representative on the Conemaugh, and elsewhere in Indiana County of the Kanawha river coal series (which otherwise must be regarded as absent altogether in Ligonier Valley) is to bring inextricable confusion into the sections, and to render a reconcilement of the First and Second Basins simply impossible.

The presence of sandstone however between A and B coals is a regular feature of the Lower Productive Coal Measures in the First Basin, and the only change this stra-

tum undergoes in crossing Laurel Hill anticlinal, is to increase in bulk and at the same time become more compact. The effect of this increase in bulk is to extend the interval between A and B coals, which we find on the Conemaugh about 75 feet increasing to nearly one hundred feet on Black Lick, whereas in the First Basin the same interval rarely goes above 60 feet, and often drops to 40 feet.

Coal Bed A'.—This seam though usually thin and unimportant to the miner, is yet one of the persistent beds of the Lower Productive group, and occurs about midway in the interval between A and B coals. It will be found in all the complete sections of the First Great Basin, and its reappearance in the Second Basin is of interest as facilitating the junction of the Allegheny River Country with the Allegheny Mountain. On the Conemaugh river, the bed is one foot thick and is very little known; it is underlaid by impure fire clay which has never been worked.

The Ferriferous Limestone of the Allegheny River.—In none of the Ligonier Valley sections is there any mention whatever of the limestone band, which on the Allegheny river occurs at an interval of about 250 feet below the Upper Freeport coal, (Bed E).

The same interval below this coal on the Conemaugh river brings us to a point in the section between A and B coals, between which beds in the Ligonier Valley there is no visible trace of this limestone so important in the Allegheny river country. In only one place in the First Basin is there any evidence of this rock, *as a limestone*, while from the Third Basin sections it would appear that the limestone is not found east of the Indiana Anticlinal Axis.

Fire Clay under Bed B.—This is an impure clay nowhere developed in Ligonier Valley and apparently too impure for brick making. On the Conemaugh river it is five feet thick.

Coal bed B.—It was stated above that on the Conemaugh river and generally throughout the Ligonier Basin, bed B comes into the measures about 75 feet above bed A, this

interval increasing at times to one hundred feet, but as often falling to fifty feet.

Throughout the First Basin *bed B* is *par excellence*, the most important stratum of coal in the Lower Productive Coal Measures. From this seam comes nearly all the steam coal at present shipped from Clearfield County; from it also is made the famous Bennington coke, which for purposes of iron making ranks second only to the Connellsville coke; and lastly it is from bed B that the Sonman coal of Cambria County is mined.

But in the Ligonier Valley, restricting this to the ConemaughCountry, and the region to the northeast of it in Indiana County, *bed* B is characterized by no such excellence. It is however almost invariably a large bed, and with the exception of *bed E*, (*Upper Freeport Coal*) it is in point of size, the most reliable bed of the series, occurring usually, just as in the First Basin, at an interval of about 200 feet below *bed E*.

Besides the impure condition of the seam in the Ligonier Basin, it is there split nearly in half by a thick band of clay shale, which becomes a regular feature of the bed north-east of the Conemaugh river.

Coal bed C.—The Conemaugh section of the Lower Productive Coal Measures shows a small seam of coal, wedged in black slate, at an interval of 48 feet above *bed B*. The same seam reappears in the Black Lick section, and at other points in the basin. It corresponds with *bed C* of the First Basin, where though small it is invariably found about midway between *beds B and D*. On the Allegheny river the same seam is four feet thick. It is frequently mentioned throughout this Report, although it is seldom mined in Indiana County, and is apparently a very unreliable bed.

Iron Ore above Bed C.—The thin band of carbonate iron ore occurring in the Conemaugh section a few feet above *bed C* has no importance economically, and probably exists only locally. Such deposits are indeed of frequent occurrence in the coal rocks, but they are usually confined to small areas of country, showing within what narrow limits were confined the conditions that prevailed at the

time the ore was deposited. Of the inconstancy of such deposits the Johnstown iron ore stratum is a good instance.

Johnstown Cement Bed.—The limestone band so important at Johnstown and throughout Somerset County is likewise present in the Ligonier Valley, where in many places it partakes of the cement nature (that is, iron and alumina enter into its composition) by which it is almost invariably characterized in the First Basin.

On the Conemaugh river at Lockport it is only two feet thick, which is a marked diminution in bulk as compared to its outcrop at Johnstown; but the deposit rapidly increases in size to the northeast in the Ligonier Basin and on Black Lick Creek it is at one place more than ten feet thick. Still further to the northeast the rock is widely known and is a conspicuous feature of the Ligonier Valley geology; it is in this Basin usually quite free from impurities and from it is derived a large part of the quarry lime used in fertilizing. But on the South Fork of Black Lick in the Second Basin of Cambria County this limestone is highly ferruginous containing at one place as much as 13 per cent. of metallic iron.

No rock in the Lower Productive Coal Measures has been a greater stumbling block to the geologists of Pennsylvania, or has given rise to more confusion and misidentifications than this *Johnstown Cement bed.* In the early surveys of the State when the sections were necessarily incomplete the ferruginous nature of the rock naturally led to its association with the Ferriferous limestone deposit of the Allegheny River, and once the two were associated nothing but confusion could follow. As the present survey advanced westward and south-westward it became evident that these two limestone bands were separated by a vertical interval of rock amounting to at least 100 feet,* and that the same relationship exists between the two, as exists between the *Johnstown Cement bed* and the *Freeport Limestone*, namely, that they are separate and distinct bands belonging to the same group of measures.

The *Johnstown Cement bed* is apparently continuous

*See Report HHH, Chap. XVIII.

north-westward across all the basins, re-appearing occasionally in Mr. White's sections of the Sixth Basin.

Coal Bed D.—Just above the *Johnstown Cement bed*, and often separated from the latter only by a few inches, although usually a thick band of impure fireclay intervenes is *coal bed D*, the *Darlington bed* of the Sixth Basin, and decribed in the First Basin reports as the Lower Freeport coal. Though thin and of little consequence, except as an horizon, on the Conemaugh river, it is four feet thick along the Black Lick Valley, and remains one of the productive beds of the series north-eastward through the Basin.

It occasionally yields, especially the lower bench of the bed, a good quality of coal that has hitherto satisfactorily met the demands made of it by the farmers and blacksmiths. Usually, however, in the Ligonier Basin the economic value of the bed is much reduced by the large amount of earthy impurities with which the coal is intermixed. In the Third Basin, as is elsewhere shown, this feature becomes even more prominent, the bed at one place being changed into a thick mass of tough cannel slate.

Being associated and often almost in direct contact with the limestone below, *coal bed D* has a local importance that otherwise would not be attached to it. The same is true of Somerset County, where in conjunction with its limestone, it is the key to the geology of the Lower Productive Coal Measures.

The Freeport Sandstone.—This is one of the widespread and recognizable sandstone deposits of the Coal Measures. In the First Basin it is a never-failing accompaniment of *bed D*, just as the *Mahoning Sandstone*, which the Freeport often rivals in thickness and compactness of bedding, everywhere overlies *coal bed E* (*Upper Freeport*) at the top of the group.

The Freeport Sandstone is even more distinctly marked as a general thing, in the Ligonier Valley than in the First Basin. It is not especially prominent in the Conemaugh section given above, because it there affects a shaly tendency which renders it more or less obscure; but this thin-bedded structure disappears almost altogether on Black

Lick Creek, and along the latter stream it is a heavy and compact mass of coarse sandstone which often stands out from the slopes in abrupt cliffs 30 feet high. This is also its character still further north on Yellow Creek and Two Lick, while the Allegheny River sections in the Sixth Basin show it to exist there as a deposit at least 45 feet thick.

Lower Freeport Limestone.—No limestone deposit of the Lower Productive Coal Measures is so variable and uncertain both in point of thickness and character as this *Lower Freeport limestone*, on which the *Lower Freeport coal* often rests directly. Usually the limestone is too impure to be of service even for fertilizing, being very frequently little more than a calcareous shale. As a guide for the identification of its overlying coal it is unreliable, and unless considered conjunctively with other better recognized horizons, it is calculated only to lead the observer astray.

It shows in a side cutting on the Pennsylvania railroad just above Lockport where it is five feet thick, but made up of very impure limestone. It is little known elsewhere in the Basin. This limestone band at Johnstown has furnished the *Lower Freeport coal* with a local name, being there known as the Limestone seam.

Coal Bed D'; Lower Freeport Coal.—Though often thin and yielding inferior coal, this bed is one of the regular features of the Lower Productive group. It was described in the First Basin reports as the *Middle Freeport coal*, but for reasons already advanced* this name has been dropped, and throughout this and succeeding reports the bed will be called D' or the *Lower Freeport* coal, to correspond with the nomenclature adopted for the Allegheny river coals.

In the First Basin *bed D'* occurs generally at an interval of about 60 feet below *bed E* (*Upper Freeport coal*) and 40 feet above *bed D*, the next coal below. These figures are reversed in the Conemaugh section, at least opposite Lockport, but they are practically restored in many of the sections to the north of the river.

In the Ligonier Basin the bed rarely yields a good quality of coal, and being very variable in thickness it is little

*See Report HHH.

worked, especially as the much thicker and more valuable *Upper Freeport coal* (*E*) is usually present in the hills wherever these are of sufficient height to include bed D'.

Freeport Fire Clay. — Directly overlying the *Lower Freeport coal*, and underlying the *Freeport limestone* at Lockport is a mass of fire clay shale fifteen feet thick. This stratum is much thicker at Bolivar, two miles further down the river and includes at the latter place, a valuable band of fire clay which is entirely absent from the measures at Lockport, where the interval between the *Lower* and *Upper Freeport* coals appears in consequence somewhat reduced. *The Freeport fire clay* is, however, a well recognized deposit, though often unfit to be used for fire bricks. Its outcrop is distinct at many places in the Ligonier Basin, and the deposit is further known at Saltsburg in the Fourth Basin and again at Brady's Bend in the Sixth Basin. It is quite extensively employed in the brick works at Bolivar, the analysis of the clay together with other particulars relating to the deposit being given in a subsequent chapter.

The Freeport Limestone.—This member of the Freeport group is a persistent stratum throughout the Ligonier Basin, yielding generally good quarry lime, but unfit for plastering purposes. North of the Conemaugh river it is quite frequently exposed, and is almost invariably associated with a small coal bed, which appears directly on top of the limestone. This small coal, though mentioned frequently throughout the following pages, deserves no special description, inasmuch as it probably exists only locally.

The Freeport limestone is almost everywhere fossiliferous the fossils consisting chiefly of minute univalve shells. It ranges through the Basin as a deposit having an average thickness of about 6 feet, and is as yet by far too little known to the farmers in those regions where it is above water level. In many parts of the Basin, the soil though naturally good, has been exhausted by overwork, and is now scarcely remunerative to those who till it. The remedy for this is within the reach of nearly every farmer, and recently a movement has been made in some districts to de-

velop the the limestones which traverse the Basin from end to end, and which have been almost totally ignored in the past. Those parts of the country in which liberal use has already been made of the limestone deposits, present indeed a striking contrast to the barren fields of the neglected regions.

Coal Bed E; Upper Freeport Coal.—This coal seam, the top stratum of the Lower Productive Coal Measures, is a wide spread bed in western Pennsylvania, and one easily recognized because of its position at the base of the *Mahoning Sandstone.* Moreover it is one of the persistently large beds of the series under discussion, and like *bed B*, 200 feet below it, is rarely an unproductive member of the group. In the Conemaugh section it is represented as eight feet thick, but this must be understood as including two large shale partings which interfere seriously with the practical worth of the bed. These partings accompany the seam to the north-east, though somewhat diminished in thickness, and even re-appear in the Third Basin to the west of Chestnut Ridge anticlinal.

The coal from *bed E* is generally of inferior quality throughout the Ligonier Basin. At one point, namely, on the Conemaugh river above Lockport, the analysis of a specimen from the main bench of the seam, gave very satisfactory results, and if this portion of the seam could be taken down independently of the inferior coal with which the lower portion of the bench is intermixed, it would doubtless yield a most superior fuel; but this plan of mining is impracticable, and the bed, taking the run of it all from roof to floor must inevitably yield impure coal, as demonstrated by the output of the mines working the seam in the vicinity of Lockport.

On the colored geological map at the end of this volume is laid down the outcrop line of bed E, not only in the Ligonier Valley but throughout Indiana County; this line shows at what points the coal goes beneath the several stream beds, and it further shows how much of the seam is attackable by drift above water level and how much must be shafted for and at what depths.

The *Upper Freeport coal* has been so frequently opened and developed in the Bituminous regions that it naturally has attached to it many local names. For the better identification of the seam a few of the First Basin names are here recalled: It is the *Lemon Seam* of Bennington, Lillys and Portage Plane No. 6; the *Coke Yard* seam of Johnstown and finally the *Hugus* seam of Somerset. The detailed chapters of this volume will show by whom it is at present mined in the Ligonier Basin of Indiana County.

The Lower Barren Measures.

Of this group of rocks usually about six hundred feet thick, not more than four hundred feet are anywhere represented in the Ligonier Basin north-east of the Conemaugh. It has already been stated that south-west of the river the entire group is included in the hills at the centre of the trough; but in Indiana County the *Morgantown Sandstone* is the highest rock with which we have to deal, and this stratum has only been preserved on a few knobs along the synclinal between the Conemaugh and Black Lick. North of the latter stream the *Nolo anticlinal* running along the centre of the valley permits of only a shallow accumulation of Lower Barren rocks in either of the sub-basins into which the great basin is split.

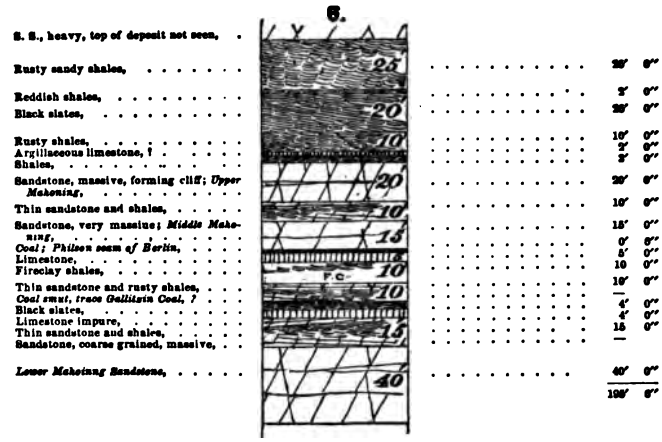
It very seldom happens that coal beds of minable thickness are found in the Lower Barren Measures. Small coals occur at various intervals in the Lower Barrens, between the *Upper Freeport coal* and the *Pittsburg seam*, and such small beds not unfrequently expand into workable seams that may in favored localities yield abundance of good coal. Such instances are however very rare, but there is at least one such occurrence on the Conemaugh river, in the Ligonier Valley, and again on Black Lick Creek in the same basin, there is good evidence that the Barrens hold two productive coal beds.

But nothing could be more capricious and uncertain than these Barren Measure coal beds, of which the Painter coal at Nineveh in the Ligonier Valley is a good example. And the evidence of this fact accumulates as the attempts to

develop the beds multiply in number. Over and over again have farmers and other property holders been led to dig into these deceptive outcrops, only to find disappointment awaiting them.

It would appear, however, that the Barren Measure coals are nevertheless persistent over wide areas of territory and are identifiable with beds elsewhere found in these measures, provided complete sections of the rocks are attainable. But such sections are infrequent in a region made up chiefly of soft argillaceous rocks which weather down into smooth hillsides on which all outcrops are concealed. A chance development on a small coal bed or limestone band is of no importance to the observer, unless he can connect it by an unbroken chain with some recognized geological horizon.

The section given below shows only a portion of the Lower Barren rocks present in the Ligonier Basin on the Conemaugh. It is chiefly important as showing the thickness of the *Mahoning Sandstone* at the base of the group, and the presence of the *Philson coal* and Limestone at an interval of 83 feet above the *Upper Freeport coal.* The section was obtained at a fine exposure of these rocks on the Pennsylvania railroad between Lockport and Lacolle, and is perhaps typical for the base of the group throughout Indiana County. Another handsome exposure of Lower Barren rocks occurs along the old canal near Nineveh, at the eastern end of the valley, but the junction between the sections being unsatisfactory they are given separately. A third partial section was obtained on Black Lick Creek near Dilltown, which is elsewhere reproduced for comparison. The section visible between Lockport and Lacolle is as follows:



The Mahoning Sandstone is a very conspicuous feature of the Ligonier Valley geology. Along the Conemaugh, and indeed along all the principal streams of the Basin, it outcrops in abrupt high cliffs, which at times skirt for considerable distances the sides of the valleys, and when forced by the geology into the uplands it covers the country with huge boulders of rock. In places it is well adapted for building stone, being composed of a tough, compact mass of fine grained sand, which, when properly tooled and dressed, resists well the action of the weather and presents a handsome appearance. The large court-house building at the county seat rests upon a foundation of Mahoning Sandstone, the same rock having also been employed to ornament the front and sides of the structure.

But in some parts of the valley the deposit is mottled with specks of iron oxide, that quickly weather out when exposed to the air, rendering the rock tender and unfit for the builder. Such changes and variations are noted in the detailed description of the Basin.

Respecting the classification of the deposit it will be observed that all the sandstone layers of the above section are regarded as belonging to the "Mahoning," the names *Upper*, *Middle*, and *Lower Mahoning* being used to distinguish the three bands into which the deposit is here subdivided. The same subdivisions can be recognized in the

basins to the west, although the partings of shale separating the layers of rock are there much thinner, and the deposit is in places a nearly continuous mass of sandstone extending for 150 feet above the *Upper Freeport coal.* This, for example, is its condition below Blairsville, and again at Saltsburg where tall cliffs rise nearly vertically from the water's edge on both sides of the river.

In the First Basin the *Mahoning Sandstone* never attains the thickness and massiveness of bedding, by which the deposit is characterized in the Ligonier Valley, and in all the basins to the north-west. In the first great trough from Clearfield County to Maryland it is a persistent deposit usually well marked, though sometimes obscure, but rarely exceeding 25 feet in thickness.

Philson Coal Bed.—Sufficient has already been said on a previous page of the unreliability of Barren Measure coals. The first seam above the *Upper Freeport bed* in the above section has been identified as the *Gallitzin coal* and the second bed as the *Philson coal* of Berlin. The latter seam was thought also to have been recognized at Nineveh where it is one foot thick. Near Lockport it is underlaid by a thick band of impure limestone as is also the *Gallitzin coal* at the same locality.

Black Fossiliferous Limestone.—This is one of the best known of all the limestone bands in the Lower Barren Measures. It is not included in the above section, although it outcrops on the left bank of the Conemaugh in the neighborhood of Lacolle. It reappears on Black Lick Creek (see Black Lick section) and was further repeatedly observed in the Third and Fourth Basins of Indiana County. In the Ligonier Basin it occurs about 225 feet above the *Upper Freeport coal.*

The limestone is usually crowded with fossil remains, of which the following were observed at various parts of the County, either in the limestone itself, or in bands of black bituminous shale lying close to the limestone horizon. I owe the determination of the various species to the kindness of Prof. J. J. Stevenson:

Polyphemopsis peracutus.
Astartella concentrica Con.
Bellerophon carbonarius Cox.
" *percairnatus Con.*
" *montfortianus N. & P.*
Lophophyllum proliferum McC.
Pleurotomaria carbonaria N. & P.
" *greyvilliensis N. & P.*
Macrocheilus primogenius Con.
Euomphalus subrugosus M. & W.
Schizodus sp.

The Morgantown Sandstone.—This, as elsewhere stated, is the highest rock seen the Ligonier Basin either on the Conemaugh river or in the region to the north-east of it. It is not shown in the Conemaugh section, but appears in the Black Lick column capping the latter section with a mass of coarse sand rock 50 feet thick. Underneath this sandstone, which is here about 400 feet above the *Upper Freeport coal*, is the *Elk Lick coal bed* of Salisbury, traces of which appear in place in the Black Lick section constructed at Dilltown. *The Morgantown Sandstone* is one of the important horizons in the Lower Barrens, being a persistent rock, which from its hard tough nature usually forms abrupt cliffs, and is thus more easily traced and recognized than the softer bands of mud rocks.

Chapter V.

Detailed description of the Mines and Developments along the Conemaugh river, in the Ligonier Basin.

The exposures and developments of the Conemaugh Valley treated of in the present chapter, are described in regular order, as they appear on the hillsides in descending the river from Conemaugh Furnace to Bolivar. The same arrangement of advancing with the description from east to west, has been adopted in discussing the geology of all the principal valleys of the Basin.

The course of the Conemaugh across the Ligonier Valley is an irregular one, the river flowing at times along the strike of the rocks, and often directly across them. At Centreville, where the rocks are horizontal, the river describes a wide loop, coming up, finally, at Lockport, against the subanticlinal axis (the Nolo anticlinal) which, on the Conemaugh, is little more than a gentle undulation, and scarcely makes itself felt in the dips.

High hills skirt the right bank (Indiana side) of the stream from one end of the valley to the other. These hills are the same, or nearly the same, at Conemaugh Furnace as at Bolivar; but at Centreville, which is about the centre of the Basin, the hills are composed of rocks which do not extend to the edges of the valley. Hence we find at Centreville an accumulation of Lower Barren rocks that are nowhere else visible on the Conemaugh in this Basin, while the slopes at Bolivar and Conemaugh Furnace are made up of Lower Productive and Conglomerate rocks, that at Centreville are buried deep beneath the channel of the river.

Conemaugh Furnace, long since out of blast and now in ruins, stands at the western end of Laurel Hill gap. Al-

most directly opposite the old stack the *Mountain Limestone* outcrops, resting here directly upon the greenish sandstones of X. On top of the limestone is a series of reddish clays and shales, which, under a 7° dip, quickly disappear beneath the river, giving place to the *Conglomerate of XII*, which fills the valley of a small run emptying into the Conemaugh near the old furnace. The same rock, here certainly one hundred feet thick, and perhaps as much as one hundred and fifty feet thick, caps a high knob at the mouth of the run, and further appears along the left bank of the river for several hundred yards below the furnace.

At this place the Lower Productive coal rocks extend some distance up the west flank of Laurel Hill; but going west they soon approach water level, the river between Conemaugh Furnace, and Nineveh flowing in the direction of the dip. An imperfect exposure of the lowest members of the group occurs in a railroad cut, about $\frac{1}{8}$ mile below the old furnace, the following rocks being visible:

Heavy, coarse sandstone,	20′ 0″
Thin bedded sandstone, in layers,	10′ 0″
Coal smut,	—
Interval; shales?	25′ 0″–35′ 0″
Sandstone, variegated, current bedded,	20′ 0″
Coal, Bed B?	2′ 7″
Coarse, sulphurous Stigmaria clay,	6′ 0″
Unknown,	10′ 0″
Clay slates,	6′ 0″
Coal smut,	trace.
Clay, impure,	3′ 0″
Sandstone, variegated, current bedded,	15′ 0″
Clay slate,	5′ 0″
Heavy sandstone,	10′ 0″
Sandstone layers, with shale bands,	15′ 0″–20′ 0″
Coal,	
Sandstone, coarse, heavy, (XII,)	40′ 0″+

The lower coals of the above section, were developed here many years ago, and employed in working Conemaugh Furnace, but no attention whatever is paid to them now. Prof. Rogers, in the Final Report of 1858, states that the coal bed "next to the lowest" was four feet thick where exposed, and that when the coal was purest and carefully

coked, it yielded a good coke, which weighed from 40 to 60 pounds to the bushel.

Baker Furnace. A better opportunity for the examination of the two lowest beds of the series is afforded at the Baker Furnace, situated a little more than one half mile north of the Conemaugh Furnace. On the Baker property both *A* and *B* coals have been mined, while *bed C* 2½ feet thick has been partially opened on the same hillside.

The developments were made close to the Furnace (no longer used) in the valley of the small run above alluded to. The lowest coal underlaid by fireclay rests upon a thick plate of massive sandstone belonging to the *Conglomerate of XII*, which is finely exposed in the ravine between the Baker and Conemaugh Furnaces. The coal is said to be four feet thick in one compact bench without slate partings. The old opening on the bed, from which much coal has been extracted in the past, is now shut.

Bed B was opened near the woolen mill at an interval of about 70 feet above the coal last described. It has further been repeatedly exposed at the base of a high bluff north of the Furnace, but these openings have been mainly deserted and are now closed. In the drift at the Woolen Mill the following section of the bed was obtained:

Slate,	[redacted]	—	
Coal,		1′ 10″	
Slate,		0′ 1″	2′ 9″
Coal,		0′ 10″	
Fireclay,		—	

The coal from this seam contains less iron pyrites than that from the bed below (Bed A), and is altogether used at present for the supply of the families in the neighborhood. It has a regular roof and floor and so far as explored is without serious disturbances of any kind, but the bed is too thin to command attention in a region so bountifully supplied with coal as the Ligonier Basin.

At Baker Furnace, sandstone and sandy shales rest upon the roof slates of *B coal*, which usually has above it a large amount of carbonated clay slates as shown in the typical section. The sandstones seen at Baker's re-appear on the

Conemaugh in the railroad cut, and there fill a large part of the interval between beds B and C.

East of the Furnace on Mr. Baker's property the land barely rises high enough to include *coal D*, which even if it touched the hills at this place must quickly disappear into the air going east under the prevailing sharp rise of the rocks in that direction. But west of the Furnace all the coals of the Lower Productive series pass under the Barren Measure rocks which gradually come in and fill the Basin at Nineveh. In this interval therefore should occur not only the higher coal seams of the Lower Productive group, but also such limestone bands as are here included in the latter series.

Passing over these rocks and descending the river to Nineveh, a handsome exposure of Barren Measure strata is found along the old canal a few hundred yards below the village. The section begins at the base with a small coal bed and extends upward continuously for 130 feet, in which interval no limestones occur, but in which there are four small coal beds; one of these seams, the highest of the section, undergoes at this place a sudden expansion of thickness, diminishing as rapidly again to its former bulk, the whole movement being here handsomely illustrated as described further on. The section is as follows:

Sandstones thin; and sandy shales,	20′ 0″
Reddish clay shales,	20′ 0″
Rusty ferruginous shales,	5′ 0″— 8′ 0″
Coal mined by Mr. Painter,	0′ 6 ′— 4′ 0″
Shales,	10′ 0″
Massive Sandstone,	10′ 0″
Indurated Shales,	10′ 0″
Shales and *coal dirt*,	0′ 6″
Impure clay,	2′ 0″
Rusty shales with ore nodules,	4′ 0″
Sandstone and shales,	6′ 0″
Dark fireclay, with calcareous nodules,	6′ 0″
Rusty shales and slates,	12′ 0″—15′ 0″
Coal smut,	1′ 0″
Sandstone,	1′ 0″
Clay shale,	5′ 0″
Sandstone,	2′ 0″
Black shales,	10′ 0″
Coal,	1′ 6 ′

These rocks most likely belong near the base of the Lower

Barrens, but it will be observed on comparison, that very little similarity exists between the above section, and that exposed near Lockport, (see section 6, page 75). It is, however, certain that the *Mahoning Sandstone* is neither so thick nor so massive at the eastern end of the Basin as at the western end, and from indications east of Nineveh, it is clear that this rock, existing here probably as one plate, goes under water level before reaching the bridge spanning the river at the village. The bottom coal of the above section would then represent either the *Gallitzin seam* of the Allegheny Mountain, or the *Philson seam* of Berlin.

Owing to the great lack of coal at Nineveh and in all the ravines heading in the back country towards Armagh, and opening towards Nineveh, the small coal bed at the base of the above section has been repeatedly opened in the neighborhood of the village, but was never found to exceed 18 inches in thickness. It is this coal that was explored by Mr. Rodgers and again by Mr. Barber at the mouth of a small run below the bridge. It yields an excellent fuel, but the seam is too small to be profitably mined.

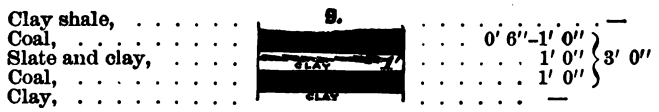
The Painter coal of Nineveh, the highest seam in the above section, furnishes an instance of the unreliability of Barren Measure coal beds. In the canal cut it is a mere trace of coal, and as such runs through the surrounding country; but on the Painter property, adjoining the canal cut, the bed suddenly increases to a thickness of five feet in one spot, and then feathers rapidly in all directions and quickly resumes its normal size of a few inches. The irregularity marks the outlines of a concavity or depression in the old surface on which the bed was originally formed.

The bed was several times opened by Mr. Painter on the face of the hill below the cut, the gangways within a few hundred feet of each other having been driven nearly straight for about 500 feet, when operations in every case were brought to a close by the gradual pinching out of the coal. The lower bench of the bed suffers chiefly in the reduction, and is nearly entirely cut out at the end of each gangway, whereas the upper bench undergoes only a slight change, and is apparently continuous. This shows the

trouble to have been caused by a shelving floor. The following section shows the condition of the bed at the mouth of the gangways:



The above section remains continuous very nearly to the end of the entries, when the following face of coal is presented:



The line of trouble runs in a direction of E. S. E., and is not of the nature of a horseback. Otherwise the bed would be likely to resume its thickness of four feet, in which event it would certainly have been found in the ravines extending northward toward Armagh, and again at Centreville, where the seam is certainly above water level, and where diligent search has failed to reveal a single coal bed of workable thickness.

The lower bench of the *Painter seam* yields good coal, being soft, friable, and reasonably clean. It is, however, nearly worked out, there remaining only what stands as pillars between the gangways. The high hill over the mine extends far up into the Lower Barrens, but fails by at least 200 feet to include the *Pittsburg coal bed.*

Between Nineveh and Centreville the river gets into somewhat higher geological ground, though the difference is slight, the stream flowing until within a short distance of Centreville (opposite New Florence in Westmoreland County) nearly along the strike of the rocks. A test boring was once made at Centreville and the *Upper Freeport coal* is claimed to have been met with about 150 feet below the river bed.* On top of the hills overlooking the river is

*This figure is given from memory, the record of the boring not being available at the time of writing.

the *Morgantown Sandstone* supporting a smooth rolling upland, which stretches north-eastward from Centreville along the centre of the Basin.

Lower Barren rocks destitute of workable coal seams continue not only in the high land back of the river, but stretch to the level of the Conemaugh, as far down nearly as Lockport, in the vicinity of which village the *Upper Freeport coal* (*bed E*) rises above water level. Thence to Bolivar the hills bordering the river are made up at their base of Lower Productive rocks, which finally give place below Bolivar to Conglomerate and sub-conglomerate measures, the barren rocks being thrust into the air on the flank of Chestnut Ridge.

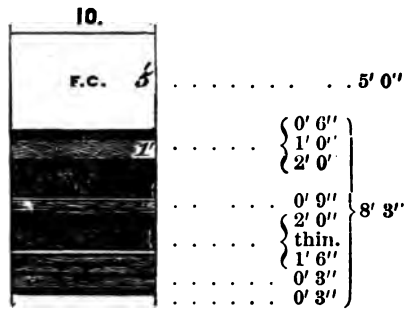
At Lockport the rock exposures are very complete and a full section of the Lower Productive Coal Measures is there obtainable as low down in the series as *bed B*, the latter seam emerging above the water at the base of a steep bluff directly opposite the village. The Lockport section is incorporated in the column of rocks shown in section 5, and is given in detail on page 65 of this volume.

Three coal beds of the Lower Productive series are of workable thickness at Lockport, and together aggregate fifteen feet of coal. These are beds *E*, *D*', and *B*; *coals D and C* being of little importance in this vicinity. Limestone abounds in the hills, the Lower Productive series alone containing as much as 17 feet of this kind of rock, while the portion of the Lower Barren group present in the hills above Lockport hold nearly as much more. Some of these limestone layers have been developed close to Lockport, and used for fertilizing, but as yet little attention has been paid to them.

The side cuttings of the Pennsylvania railroad above the village give a handsome *exposé* of the *Mahoning Sandstone*, the whole deposit being presented in a succession of tall cliffs made up chiefly of compact, massive sandrock. It is too impure for glass-making, but its lower layer, directly above the *Upper Freeport coal*, would make good building stone. It slowly ascends the slopes in approaching Chestnut Ridge, and caps the hills at Bolivar.

The Upper Freeport coal is the bed chiefly mined at Lockport to supply the demands of the surrounding country. It first appears on the D. Harris farm, about one mile above the village, and was again opened close by on the opposite side of the river by Mr. Gardiner for use at the Lockport brick works. It was further exposed on the Fulcomer lands, and again by Mr. Reid on the hill facing the village from the north. It is the principal bed of the lower series at Lockport, as well from its thickness as from the superior quality of coal yielded by its middle bench. Both the upper and lower benches are quite impure, and are usually allowed to stand in mining.

On the Harris farm, where the bed has been considerably developed the following section is exhibited in the mine:



A measurement of the same bed in the Reid mine opposite Lockport gave a section almost identical with the above, thus showing that the seam here runs evenly and regularly.

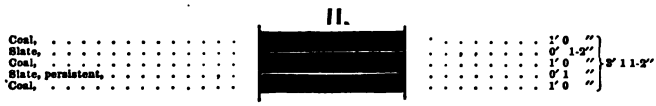
Two analyses were made by Mr. A. S. McCreath of specimens selected at random from the main bench of the bed as exposed on the Harris property. The first of these analyses represents the upper portion of the main bench, and shows a most excellent quality of coal containing little water, and a minimum of sulphur and ash. It is however quite friable and would not bear transportation well, but would doubtless make good coke.

The lower portion of the main bench is both pyritous and slaty, and by reason of its slaty nature, is more firm and tough than the coal from above the thin parting, and min-

ing out in large irregular blocks it is more convenient for domestic use. The analyses, placed side by side for convenience of comparison are as follows:

	Upper portion.	Lower portion.
Water,	.660	.450
Volatile matter,	24.467	24.215
Fixed carbon,	71.900	60.947
Sulphur,	.588	1.173
Ash,	2.385	13.215
	100.000	100.000
Coke, per cent.,	74.873	75.335
Color of ash,	Cream.	Grey, red tinge.

The Lower Freeport coal is only two feet thick where exposed on the railroad below the Harris mine, but the same bed shows three feet of coal on the Reid property, having there been opened at an interval of 40 feet below *bed E.* It yields an indifferent fuel much intermixed with slate, a thin but persistent band of which ranges about one foot above the floor of the coal and is a regular feature of the seam in this locality. On the Reid farm the bed shows this section:

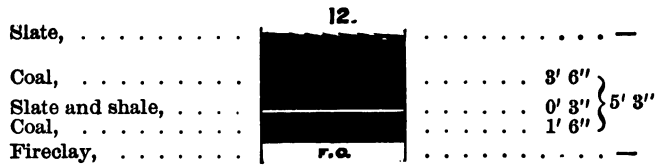


Coal D underlaid by the *Johnstown Cement bed* outcrops 65 feet below Coal D^4, and has been opened up by Mr. D. Reid, both coal and limestone being exposed. The coal is about 18 inches thick rarely going above this figure on the Conemaugh but increasing in bulk to the north-east. It is separated from its underlying limestone by an interval of shale and impure clay amounting to six feet. On the Reid farm the limestone is in part of a cement nature and is four feet thick, but on the adjoining farm of Mr. Fulcomer the same limestone is reduced to 18 inches, and is almost directly underneath the coal.

The Freeport Sandstone roofs *Coal D* on the Reid hill, the rock being there conspicuous, though divided into two layers by a considerable interval of sandy shale.

Coal bed C is only one foot thick at Lockport and about the same size at Bolivar. The rocks intervening between this coal and *bed D* are here chiefly made up of clay slates and shales, in which a small band of carbonate iron ore outcrops. The same ore band, though reduced in thickness likewise appears in the exposures at Bolivar.

Coal bed B, five feet thick in two benches is exposed close to the waters edge nearly opposite Lockport, where a sharp curve of the river has produced a steep high bluff along the right bank, the rocks dipping south-east across the river and into the bluff. The coal from *bed B* in this locality is impure, and has been very little used. It rests upon a stratum of impure fire clay and is overlaid by a thick mass of carbonated clay slates. The opening on the bed at Lockport was made many years ago, and has since been deserted, but the following section of the seam is yet visible at the mouth of the old drift:



The developments at Bolivar, a small village at the eastern end of Packsaddle Gap, and about one mile below Lockport, are chiefly confined to the fireclay bands, one of which is a member of the Freeport group of rocks, and the other underlies *coal bed A*, at the base of the Lower Productive Coal Measures, this whole series being above water level in the hills at Bolivar.

Several clay works have been established at this village on the fireclay deposits, the clay being good, abundant, and close at hand, while the bricks and retorts made from it are highly esteemed. Moreover, the clay works at Lockport owned and operated by Mr. Gardiner, derive their supply of clay almost entirely from the Bolivar hills, the plastic variety being underneath the river bed at Lockport, while the Freeport deposit is there, thin and worthless.

The fireclay belonging to the Freeport group, is from 15

to 20 feet below *bed E.* It is conveniently situated for mining, and has been worked on nearly all the hills close to the village. The deposit is very variable in thickness, varying from 3 to 8 feet in height, and yields a smooth even clay quite free from impurities. It is overlaid by shale and rests upon a similar rock, the following section showing the strata which intervene between the clay and the *Upper Freeport coal:*

Coal, U. F.,	—
Clay and sandy shales,	6′ 0″
Shales with ore masses,	2′ 6″
Sandstone and sandy shales,	8′ 0″
Fireclay,	8′ 0″

Mr. McCreath analyzed specimens of both the hard and plastic varieties of the clay. In each instance, as will be observed by consulting the figures given below, a considerable amount of titanic acid was found. Attention is here specially directed to the presence of this mineral, because in all his analyses of Pennsylvania clays Mr. McCreath has been particularly careful in his tests for titanium, and has not yet in a single instance failed to discover it, although sometimes existing in very small quantities. The recent report of Messrs. Cook and Smock on the Clay Deposits of New Jersey (1878) shows it to be an almost unfailing constituent of the clays of that region, where it also occurs in small quantities, but in amounts that remain remarkably constant.* In how far the refractory power of the clay is affected by the presence of titanium is not yet understood; but when present in such small amounts it likely exerts little influence one way or the other. The subject is however of considerable scientific interest, and is receiving careful investigation from Mr. McCreath.

The analyses of the Bolivar fire clay are as follows:

* Report on the Clay Deposits of Woodbridge, South Amboy, and other places in New Jersey; pp. 274–276.

	Hard.	Plastic.
Silica,	50.840	59.830
Alumina,	30.745	24.580
Protoxide of iron,	3.213	1.655
Titanic acid,	1.260	1.170
Lime,	.160	.280
Magnesia,	.288	.872
Alkalies,	.541	3.114
Water, &c.,	13.050	7.830
	100.097	99.331

Prof. Stevenson observed the *Upper Freeport fire clay* at a number of localities in the Ligonier Valley south of the Conemaugh. He states that the stratum is quite persistent in Fayette County, having traced it across the Youghiogheny and on towards West Virginia. In these southern districts its composition is very similar to that given above.*

The coal used in the brick works at Bolivar, is taken mainly from the *Upper Freeport bed* (E). It is mined on both sides of the river, and shows a section at both places corresponding to that given above in connection with the description of the Harris mine.

A small amount of coal is derived from *bed A*, which is mined in conjunction with its underlying clay. The bed is only about 25 feet above the river, where worked by Mr. E. Robinson on the right bank of the stream opposite his clay works. It yields from 18 to 20 inches of coal, and is overlaid by a stratum of compact sandstone thirty feet thick.

Bed B was also opened by Mr. Robinson, on the same hillside, at an interval of 80 feet above *bed A*. Its thickness is given as 5 feet, which corresponds with its dimensions at Lockport, and also at the Wm. Reynolds mine, about one mile north of Bolivar.

Continuing up the hillside, extending north from the river, the Lockport section is repeated, though the exposures at Bolivar are less complete. The *Upper Freeport coal* appears near the top of the hill, its outcrop being confined to a belt of high land enclosed on the east and west by Laurel

*See Report KKK, p. 249.

and Roaring runs. It leaps the ravine of Laurel Run and passes into the country to the east, but does not extend west of Roaring run, in which ravine the Conglomerate of XII is exposed (see map).

On the Robinson property opposite the clay works at Bolivar, *bed E* is 230 feet above *bed B*—the usual distance between these coals in the Ligonier Basin. The rocks making up the interval between these beds have been but little developed at Bolivar.

Conglomerate and *sub-conglomerate rocks* rise above water level in descending the river from Bolivar, more than one thousand feet of these measures being exposed in the sides of Packsaddle gap.

The Conglomerate of XII, 65 feet thick in all, shows in the railroad cuttings just west of the village. The rock is here divided into three parts, as already described on a previous page. It is overlaid by a small coal seam, representing *bed A*, while at the base of the formation, the reddish shales of XI join on directly to the massive sandstone. The rock here rises sharply towards the northwest, and the Conglomerate quickly ascends the flank of Chestnut Ridge, and occupies the summit of the mountain at the centre of the gap.

Formation XI is also completely exposed along the railroad below Bolivar. The group is chiefly made up of red and olive clays, but includes also two thin bands of sandstone. The *Mountain limestone*, 40 feet thick, is exposed on both banks of the river and forms the base of the group in the gap below Bolivar.

The limestone, very siliceous and much current bedded, rises above the river opposite the house of Mr. Jacob Bridge, near which point it is quarried by the Pennsylvania Railroad Co., on the left bank of the stream.

Several small runs draining shallow and narrow valleys extend southward from the Cambria pike, and join the Conemaugh in the vicinity of Bolivar. The most westerly of these streams is *Roaring Run*, which starts on the summit of Chestnut Ridge, and afterwards flows along the base of the mountain, chiefly in rocks below the Lower Productive

Coals. Ascending the run, at the mouth of which the *Mountain Limestone* rises above the river, the *Conglomerate of XII* and the *shales of XI* make up the western slopes until near the head springs of the stream. The hill skirting the run on the east holds the *Lower Productive coal beds* as far north as the Brendlinger mine, where the uppermost coal of this series (*bed E*) leaves the valley. Chestnut Ridge has a thin covering of coal rocks at the point where it is crossed by the Cambria pike, and the run starting in this latitude flows over the lower coal beds for more than a mile, but passes out of these rocks and into the Conglomerate below the Brendlinger property, beyond which the ravine is uncultivated, being filled with large fragments of massive sandstone.

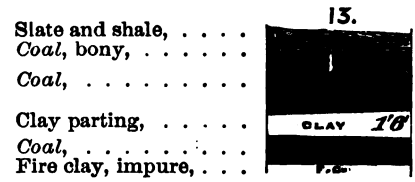
Laurel Run.

Of more importance economically than the ravine occupied by Roaring Run, is the valley of Laurel Run, which joins the river at Bolivar. The bed of the run has a very gentle slope, and the measures prevailing at Bolivar extend up the little valley, outcropping on both slopes as far north as the Wm. Reynolds farm, where the explorations made from time to time have revealed all the coals and limestones of the Lower Productive series, with the exception only of *bed A*, which, at Mr. Reynold's house, is below the level of the run. At this place the run bends westward (going north) in the direction of the rise of the measures, the effect of which is to throw the *Upper Freeport coal* from the hills along the west bank of the stream. This is better expressed by the geological map at the end of the volume.

Section at Reynolds'.

Ascending the hill on the Reynold's farm, the section starts at the level of the run with *bed A'*; this seam is here one foot thick and is overlaid by obliquely bedded sandstone, in which are small lenticular masses of coal. Thirty feet higher, *bed B* is opened, showing nearly 5 feet of coal, but parted by a thick band of soft impure clay. The bed is both pyritous and slaty, the lower bench especially so. It has also been opened and is mined on the adjoining prop-

erty of Mrs. Brendlinger, the section at both places being the same. The measurements made are as follows:



Nearly 60 feet above this seam, *bed C* outcrops, and 40 feet still higher is the *Johnstown Cement seam*, here composed of good limestone, semi-crystalline and fossiliferous. *Coal bed D* is visible directly on top of the limestone, but has never been explored. Thence to the *Freeport fire clay* the rocks are concealed, but judging from the developments in the Germany settlement, in the ravine of Richards run, *bed D′* is likely three feet thick on the Reynolds hill. *The Freeport clay* makes a conspicuous outcrop on the steep hillside, as does also the *Upper Freeport coal* 20 feet still higher. This last seam has abundance of cover on the Reynolds farm, and in this condition runs southward to the river, but in the fields of the Brendlinger farm, north of Reynolds, the coal makes the hilltops, and soon disappears from the west slope of the valley as before explained.

Richards Run.

The valley of Richards Run is parallel to Laurel Run, but to the east of it, and occupies, therefore, higher geological territory than either of the ravines above described. The valley, divided up into farms and under cultivation, is quite picturesque, the run forking again and again near its head springs and sending its branches up little ravines to the east and west.

The geology of this valley is complicated slightly by the subordinate anticlinal axis of the Ligonier Basin which crosses the run in the Germany settlement, about one mile from the river. It is due to this subordinate roll, which is here however very gentle, that the reverse (N. W.) dips are felt in the mines near the Methodist Church.

Beyond this one complication the geology is exceedingly simple, the valley along the base of the hills consisting of

Lower Productive Coal rocks, on top of which come in the Lower Barrens. The lowest rock exposed is at the mouth of the run, where *coal bed B* is above water level, the run emptying into the Conemaugh, between Lockport and Bolivar. The highest measures found in the valley of Richards Run are on the east bank of the stream, the dip being generally southeast across the valley into the Barren Measure plateau at the centre of the basin. Ascending the valley to the Methodist Church, in the Germany settlement, *bed C* is at water level, the run falling nearly 60 feet between the church and the river, and overcoming the interval between B and C coals. Thence to the head springs of the run the geology undergoes little change.

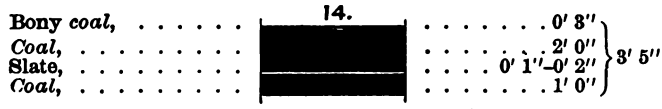
The Mahoning Sandstone capping the *Upper Freeport coal* is a very prominent feature of the valley, the slopes being often covered with large sandstone blocks. This is especially noticeable near the lower Germany church, where a small branch of Richards Run extends eastward past Gamble's mill. In this little branch-valley the *Mahoning* is also conspicuous, descending finally to water level at the grist mill, beyond which the slopes are entirely made up of soft Barren shales, one small coal bed having been opened in these latter measures on the farm of Mr. Johns. The *Mahoning sandstone* in the Richards Run valley has usually a mottled appearance, but is sometimes quite free from iron; it is very massive, slightly conglomeritic, and has exercised an important influence over the general topography of the valley.

The Upper Freeport coal (E) is nowhere worked along Richards run, although its outcrop runs along both sides of the valley as far north as Mr. S. Kline's house, at which point it is thrust from the hills bordering the *west bank* of the stream, by the rapid northwest rise of the rocks. Along the *east side* of the valley the outcrop of this coal forms an unbroken line, crossing the pike near Mr. Clark's house, and descending thence into the valley of Black Lick (see map). It will be remembered that this coal is 6 feet thick at Lockport and Bolivar, and the same thickness is claimed for it in the Germany settlement, where it is

said to have been explored some years ago. All these openings on the coal are now closed.

Bed D' is the coal principally worked in the valley. It is exposed on nearly every farm along the west bank of the run, starting with the property of J. Sides at the lower Church, and ending with Palmers at the pike. It runs with great regularity throughout the valley, maintaining an average thickness of 3½ feet, and is known to the farmers as the "four-foot bed."

In the Sides mine this thickness is reduced to about 2 feet, owing to a local irregularity similar to that which affects the bed on the Conemaugh above Lockport, in which vicinity the same section is displayed as at Sides'. But in the Walbeck mine, ¼ mile to the northeast of the Methodist Church, the bed resumes its full size, showing this section:



The small slate parting so characteristic of the bed on the Conemaugh at Lockport is present also in the Germany settlement as shown by the above section.

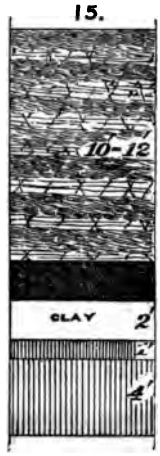
The Lower Freeport limestone appears in place beneath its coal on the farm of Mr. S. Kline at the northeast end of Fort Hill, a high oblong knob skirting the west bank of Richards Run and extending from Mr. Kline's house to the river.

Coal bed D together with the underlying *Johnstown Cement seam*, is exposed on the farm of Mr. J. Sides, by whom the limestone is quarried and used in considerable quantities for fertilizing purposes. The coal bed is only 18 inches thick at the quarry, (the same thickness as at Lockport,) but where once opened by Mr. Gamble, near the cemetery at the northern end of the valley, it showed three feet thick, parted by nearly one foot of clay shale. In the Richards run valley the bed is 45 feet below *bed D'*, and about 50 feet above *bed C.*

The Johnstown Cement is an important band of limestone in this valley, measuring here between four and five feet thick, and composed of good limestone, which slakes

down easily into a grayish lime. It is quarried at present in this valley only by Mr. Sides, at whose quarry the following section was obtained:

15.



Shales, with thin bands of S. S., *Freeport*, . .	10′ 0″–12′ 0″
Coal, Bed D, ...	1′ 8″– 2′ 0″
Clay, impure, ...	2′ 0″
Limestone, ferriferous,	1′ 0″
Limestone, good, . .	4′ 0″ — 5′ 0″

The same rock appears in the township road between Mr. S. Kline's house and the run, at an interval of 60 feet above water level. This point of outcrop is directly opposite the mine (on bed D′) of Mr. Brendlinger, by whom bed C was exposed at the level of the run. The coal, one foot thick, is wedged in black slate, thus corresponding with its condition at Lockport.

The following section was made on the east slope of Fort Hill, at the Germany settlement:

Sandstone, thin bedded, hill top, ...	—
Interval, concealed rocks, ...	100′ 0″
Black slate and *coal outcrop, bed E*, ...	—
Interval, ...	63′ 0″
Shales, ...	10′ 0″
Coal, bed D′, ...	2′ 0″–3′ 6″
Limestone, *Lower Freeport*, ...	—
Interval, ...	30′ 0″
Thin sandstone and shales, *Freeport S. S.*, ...	15′ 0″
Coal, bed D, ...	1′ 6″–3′ 0″
Clay, ...	2′ 0″
Limestone, *Johnstown Cement*, ...	5′ 0″
Interval, ...	32′ 0″
Slates, ...	10′ 0″
Coal, bed C, ...	1′ 0″
Slates, ...	5′ 0″
Richards Run, ...	—

Chapter VI.

Detailed Description of the Mines and Developments along Black Lick Creek in the Ligonier Basin.

Between the Conemaugh River and Black Lick Creek, in the Ligonier Basin, ranges a belt of smooth high land, the surface of which, deeply gashed in places by ravines extending north and south, is composed of Lower Barren rocks, excepting along the flanks of Laurel Hill and Chestnut Ridge. The region so included embraces the Wheatfield townships, a name at once suggestive of deep fertile soils, which are the product of the disintegration of the prevailing surface rocks.

Through the centre of these townships and along the highest land runs the Indiana and Cambria turnpike, which, from Mr. Clark's house on the east slope of Chestnut Ridge, to the Ling property east of Armagh, traverses Lower Barren rocks. At one point, namely, at the Stone House between Armagh and Ling's, the road is nearly four hundred feet above the *Upper Freeport coal bed.* The developments and explorations made by the farmers along the pike belong to the details of the Black Lick Valley, and are incorporated in the description given below of the latter region.

The course of Black Lick, though not exactly parallel to the Conemaugh, is yet in effect the same, both streams flowing generally west and northwest *across* the Basin. But in spite of the similarity in the direction of the two streams, the geology displayed along Black Lick differs in many respects from that described in the last chapter. Precisely the same rocks compose both valleys; the difference in tide water level between the surfaces of the two

streams is everywhere trifling in this basin; yet certain points along Black Lick corresponding in position to the shallowest parts (*geologically*) of the Conemaugh Valley are the deepest along the first named stream, while certain other points among the deepest on the Conemaugh correspond in position to the shallowest parts of Black Lick. To verify this statement the reader has only to compare the geology at Baker's Furnace with that exhibited at the old Black Lick Furnace, the latter being scarcely more than three miles northeast of the former, and along the strike of the rocks. Under such circumstances one would naturally expect to see the conditions of the one place repeated at the other; but so great is the fall of the Laurel Hill anticlinal in this distance of three miles, a fall, moreover, participated in by the rocks at the base of the mountain, that a difference of nearly four hundred feet exists between the geological horizons of the two places, and instead of the Conglomerate and Lower Productive hillsides, prevailing at Baker Furnace, we find at the old Black Lick Furnace Barren Measure slopes two hundred and fifty feet in height; near the base of these slopes is the Black fossiliferous limestone, itself two hundred feet above the highest coal of the Lower Productive Measures. This explains the absence of workable coal beds above water level in the region of Black Lick Furnace, and why it is that all efforts to find such in the interval between the old Furnace and Dilltown, either on the hills extending southwest towards the Pike, or northeast into Buffington township, have been and must be unavailing.

Again, to compare the country between Centreville and Lockport with that between the old Buena Vista Furnace and the mouth of Brush Creek on the Black Lick is to discover that of the Lower Barren rocks, of which the hills are entirely composed at the first named locality, scarcely a vestige remains on the Creek, and what is there left of them is forced to the very highest land, thus giving place to the Lower Productive Coal Measures, and even to the Conglomerate of XII. Instead, therefore, of the smooth arable slopes at Centreville, steep rugged hillsides prevail at the Buena Vista Furnace, and the country has remained

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a wilderness, excepting along the uplands, which are covered by Lower Barren rocks.

This last change in the geology has no immediate connection with Laurel Hill, but has been effected by the *Nolo anticlinal*, the sub-anticlinal axis of the Ligonier Basin, an axis whose force, gradually weakening southward, was nearly exhausted before reaching the Conemaugh, and, in consequence, was there unable to push the lower rocks upwards to the same level that they are found on Black Lick, along which waters the anticlinal exercises a potent influence, and is one of the main features of the valley.

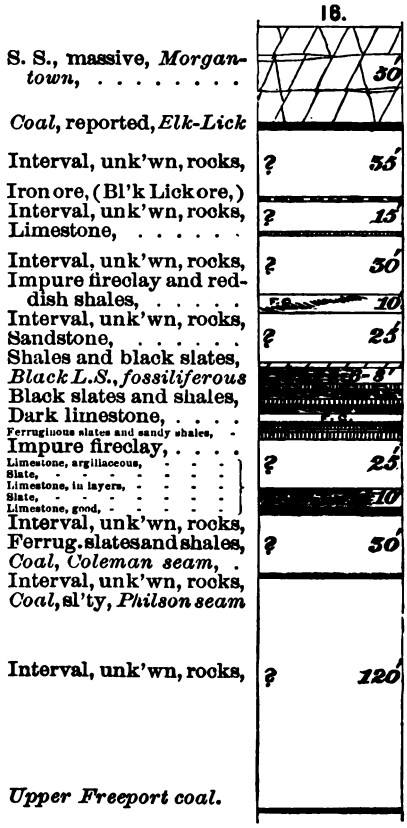
Moreover, the greater violence of the Nolo anticlinal on Black Lick, renders shallower along the latter stream the westerly sub-division of the Basin, as shown by the difference in the geology of Heshbon and the region between Lockport and Bolivar on the Conemaugh, the portion occupied by Heshbon corresponding with the last named. But below Heshbon in the gap of Chestnut Ridge, the country rock at the water level of the Black Lick at the centre of the anticlinal is nearly six hundred feet higher in the measures than it was at the corresponding point in the Conemaugh gap of the same mountain, six miles to the south-west. Like the change along the summit and flanks of Laurel Hill, this geology has been produced by a similarly rapid decline of the Chestnut Ridge anticlinal, of which sufficient has already been said in a previous chapter.

From the above brief *resumé* of the geology of the Black Lick Valley in the Ligonier Basin, it is clear that the eastern sub-division of the trough is in this latitude chiefly composed at the surface of Lower Barren rocks, while west of the Nolo anticlinal these measures are only scantily represented in the Basin.

The section of Lower Barrens exposed along Black Lick between the Cambria County line and Dilltown embraces over four hundred feet of rocks, in which are included three small coal beds and several limestone layers. Besides these, there is a band of carbonate iron ore, which ranges near the top of the section, and which is known generally by the local name of the "Black Lick ore."

This ore stratum was at one time extensively worked, supplying not only the Black Lick Furnace with material for smelting, but also the Buena Vista Furnace below Dilltown, and even the Baker Furnace on the Conemaugh. *The Morgantown Sandstone* is the highest rock (geologically) in this valley ; it leaves the basin at Dilltown, being forced into the air by the *Nolo anticlinal* but it extends southwest from the creek along the centre of the Basin, and is conspicuous on the Cambria pike near the Stone House east of Armagh. It is a heavy, compact rock, often conglomeritic and at least fifty feet thick.

A tolerably complete section of the Lower Barrens from this rock downwards to the *Upper Freeport coal* was constructed along Black Lick with the following results:



S. S., massive, *Morgantown*,		50′ 0″
Coal, reported, *Elk-Lick*		3′ 0″
Interval, unk'wn, rocks,	?	35′ 0″
Iron ore, (Bl'k Lick ore,)		0′ 6″– 2′ 0″
Interval, unk'wn, rocks,	?	15′ 0″
Limestone,		1′ 0″– 2′ 0″
Interval, unk'wn, rocks,	?	30′ 0″
Impure fireclay and reddish shales,		10′ 0″
Interval, unk'wn, rocks,		25′ 0″
Sandstone,	?	3′ 0″
Shales and black slates,		6′ 0″– 8′ 0″
Black L.S., fossiliferous		3′ 0″
Black slates and shales,		6′ 0″
Dark limestone,		3′ 0″
Ferruginous slates and sandy shales,		4′ 0″
Impure fireclay,		4′ 0″
Limestone, argillaceous,		1′ 0″
Slate,		0′ 8″
Limestone, in layers,	?	2′ 0″
Slate,		1′ 0″
Limestone, good,		4′ 0″
Interval, unk'wn, rocks,		25′ 0″
Ferrug. slates and shales,	?	10′ 0″
Coal, Coleman seam,		3′ 0″
Interval, unk'wn, rocks,		30′ 0″
Coal, sl'ty, *Philson seam*		2′ 0″
Interval, unk'wn, rocks,	?	120′ 0″
Upper Freeport coal.		—
		401′ 8″

Though the *Lower Productive Coal Measures* outcrop at the eastern end of the valley, in the ravines at the base of Laurel Hill, these rocks can be studied to better advantage, because more frequently exposed, at the western end of the trough, namely at Heshbon, where all the coals of the Lower Productive Series have been developed by the farmers.

This section including both the *Mahoning Sandstone* and the *Pottsville Conglomerate* (*XII*) may here be introduced, leaving the discussion of its different members to follow with the detailed description of the various exposures of these rocks at different points in the Valley.

17.

Mahoning Sandstone, .		—
Coal, bed E, *U. F.*, reported, ...		4′ 0″
Interval, unexpl'd rocks	? 70′	70′ 0″
Coal, bed D′, *Lower Freeport*, ...		?
Interval, unexplored, .	? 20′	20′ 0″
Sandstone, *Freeport*, .	15′	15′ 0″
Coal, bed D, thickness unknown, ...	0	—
Impure fireclay and slate, . . .		6″ 0″
Limestone, *Johnstown Cement* seam, . .		8″ 0″
Interval, unexpl'd rocks	? 45′	45′ 0″
Coal, bed C, ...		4′ 0″
Interval, unknown, . .	? 30′	30′ 0″
Slates, rusty, ferruginous	15′	15′ 0″
Coal, bed B, ...		3′ 0″
Fireclay, impure, ...	F.C. 3′	5′ 0″
Shales, with ore nodules, ...		5′ 0″
Sandy fireclay, ...	F.C. 10′	10′ 0″
Shales, ...	10′	10′ 0″
Coal, bed A′, ...		2′ 0″
Sandy shales, ...	20′	20′ 0″
Tough grayish slates, .	10′	10′ 0″
Coal smut, ...		thin.
Sandstone, ...	30′	30′ 0″
Shales, ...		8′ 0″
Coal, bed A, ...	3′	4′ 0″
Clay, impure, ...		2′ 0″—3′ 0″
Sandstone, thin bedded, *Piedmont S. S.*, . . .	20′	20′ 0″
Concealed, sandy shales?	? 25′	25′ 0″
Massive S. S., coarse, massive compact, XII,	25′	25′ 0″
		394′ 0″

The section shows little change from its condition on the Conemaugh; the same coal beds re-appear, separated by nearly the same intervals, and if these intervals were more thoroughly examined and explored, they would doubtless be found to contain the same limestone bands that prevail along the river.

Clark mine. The coal once mined by Mr. Clark near the headwaters of Laurel Run, which is crossed by the Cambria pike at the foot of Laurel Hill, came from a bed near the base of the Lower Productive group. The same bed was long afterwards developed to supply the Black Lick Furnace with fuel. It is said to exist as a double seam parted by a thick band of soft clay; the upper bench however is now all that is visible at the old works. It measures four feet thick and is overlaid by a heavy mass of black slates. These conditions would indicate the presence of bed B at this place.

On the unexplored hillside rising westward above the mine come in all the higher coals of the Lower Productive series. Advancing in the direction of the dip, the uppermost coal of the group appears on Mr. Ling's farm, where it has been explored, measuring 3½ feet thick. Still further west, the Lower Barrens make up the country rock.

Ritter Furnace. It was shown in the Report of Progress for 1875 that the Lower Productive Coal Measures are above water level at the old Ritter Furnace, which stands at the forks of Black Lick, on the dividing line between Indiana and Cambria Counties. It was further stated in that Report that the iron ore band once worked at the forks of the creek, for the supply of Ritter Furnace is at the top of the Lower Productive Coal Measures. The stratum must not, however, be confounded with the "Black Lick ore" of the Black Lick Furnace region, which, as shown above, occurs high up in the Lower Barren group.

After crossing the Indiana County line, Black Lick flows a nearly due west course for about a mile, and the Lower Productive rocks disappear under the creek bed. Bending then to the south-west it runs along the strike of the rocks to Black Lick Furnace, the geology of the Valley in this

distance undergoing little change. Below the Furnace, at which point the synclinal axis crosses the Valley, the creek flows west and north-west to Dilltown, the rocks rising in the same direction towards the Nolo anticlinal. This forces the Lower Barrens above water level and Lower Productive rocks appear below Dilltown.

The Lower Barren rocks have been thoroughly explored on the Kern property below the Black Lick Furnace, and again on the Stevens farm near Dilltown. The section as here obtained shows several small coal beds besides a great abundance of limestone.

Mr. Kern has failed to discover a single workable bed of coal above water level on his farm, and it is unlikely that a bed of minable dimensions exists there. Several seams have been found at various intervals, but none exceed one foot in thickness. This, moreover, is the size of the Elk Lick bed for which, however, on the Stevens farm a thickness of three feet is claimed. The lower coals of the section have been mined at Dilltown on both sides of the creek, but these are below water level on the Kern farm.

The black fossiliferous limestone has been finely exposed by Mr. Kern, together with a smaller but much purer stratum which occurs about seventy feet higher in the measures. The black limestone shows here some variation from its form of deposit at Dilltown, as follows:

Limestone, dark,	4′ 0″	
Limestone impure in layers separated by carbonated slates,	3′ 0″	11′ 0″
Impure fireclay,	2′ 0″	
Limestone and shales,	2′ 0″	
Fireclay, very dark,		3′ 0″
Iron ore,		0′ 6″
Shales,		—

The "Black Lick ore" was benched on nearly every hillside close to the Furnace. It ranges as a persistent deposit, varying from six inches to two feet in thickness; resting in shale it can be cheaply mined, and a sufficient amount of ore was easily obtained near at hand, for the supply of the small furnaces once dependent upon it for

support. The ore is rather coarse grained, of a bluish cast, and to all appearances rich in iron.

The gradual northwest rise of the rocks is indicated by the ore benches, which, starting at the extensive stripping about 1½ miles above the Furnace, extend westward past the Methodist Church, and up the small ravine on the Tinckcome property, where the ore was worked for nearly a mile on both banks of the run. It was also explored on the Kern farm.

Advancing to Dilltown, the lowest Barren Measure coals as yet explored in this region are visible at the grist mill on the Stevens property. These coals, measuring respectively two and three feet thick, and separated by thirty feet of rock, have been mined by Mr. Stevens, and have further been explored on the J. Tomb property to the south of the Dilltown bridge. From the grist mill the section extends northward past Mr. Stephens' house to the top of a high knob capped by the Morgantown Sandstone. It, therefore, embraces all the rocks given in Fig. 16.

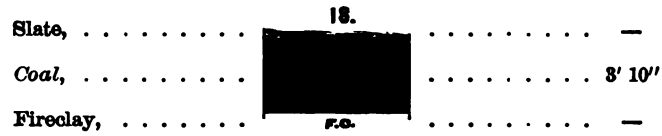
The black fossilferous limestone has been exposed on the Stevens' hill, as also the *Black Lick ore*, the latter stratum appearing near the top of the hill, and measuring, according to Mr. Stevens, two feet thick.

A test hole for oil was drilled some years ago to a depth of nearly 1,200 below the level of the creek at Dilltown bridge. The record of this drilling, which started at the top of the Lower Productive Coal Measures, and extended downward nearly, if not quite, to the base of For. X, is no longer obtainable.

The northwest rise of the rocks brings the *Upper Freeport coal* (bed E) to daylight about one half mile below Dilltown, whence to Heshbon the outcrop line of this coal follows along both sides of the creek. It runs up all the small ravines, which widen into the Black Lick Valley; and it preserves an unbroken line across the Nolo anticlinal, shooting out finally into the air on the flank of Chestnut Ridge.

Dill mine. The bed is exposed on several farms below Dilltown. It shows on both sides of the creek at McCartney's

mill, being here quite extensively developed on the north bank of the stream by Mr. J. C. Dill, in whose mine the following section is exhibited:



The bed is without persistent or injurious partings of slate, but yields a rather pyritous coal. Above the mine occur 30 feet of black slates, on top of which a small seam of coal is said to outcrop. Sandstone appears above the slates. These conditions are repeated on the opposite bank of the stream, and again on the Tomb farm at the Big Bend.

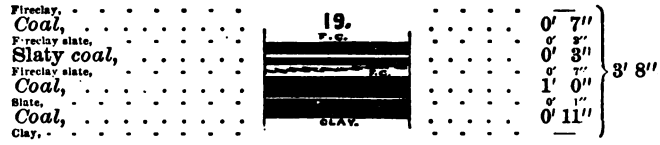
Still further west a bed of coal, similar in appearance and dimensions to the above, is mined on the D. Killen farm. This is also most likely the *Upper Freeport bed*, which, at the Killen mine, is 160 feet above the creek level. A hill rises southward over the mine for 300 feet, terminating in a small round knoll, in which the *Black Lick ore* was once worked.

Below Mr. Killen's mine a small nameless run comes into the creek from the village of Armagh, on the Cambria Pike. Armagh is built upon Lower Barren rocks, which prevail along the pike west of the village, the measures continuing to rise in this direction towards the Nolo anticlinal, which crosses the pike near the village of New Washington, two miles west of Armagh. In all this distance the surface of the upland is covered with Lower Barren shales, and the small run at Armagh, therefore, starts in this group of rocks, but passes below these measures and into the Lower Productives before reaching the creek.

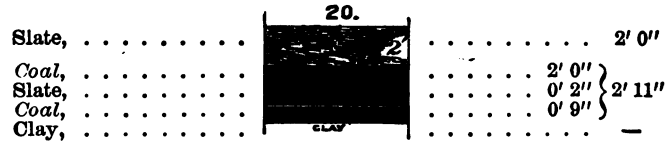
Campbell Mine. About one half mile below Armagh a bed of coal and slate four feet thick was opened at the level of the run on the A. Campbell farm. Thirty feet higher in the measures there is another coal seam 3 feet thick. Neither of these beds correspond with that mined by Mr. Killen, although the mines are nearly on a level, and

along the strike of the rocks. The rapid rise of the Nolo anticlinal to the northeast sufficiently explains the difference in the horizons, the coals at Mr. Campbell's corresponding doubtless with the beds (*Philson* and *Coleman*) once worked by Mr. Stevens at the grist mill near Dilltown.

The lower of the two beds, as opened by Mr. Campbell, is too much intermixed with slate and other impurities to be mined profitably, even in a small way for domestic use. Nor is there any reason to believe that the condition of the bed will improve as the gangways advance under the hill. At the present face of the mine the bed shows thus:



The higher of the seams yields much better coal than the bed above described, but is itself slaty and impure. It has been mined on the opposite bank of the run from Mr. Campbell's drift, showing thus in one of the gangways on Mr. J. Tomb's farm:



Buena Vista Furnace stood on the right bank of Black Lick, about one-half mile below the mouth of the Armagh Run. The ore supply at this place seems to have been inconstant and irregular, and the Furnace was long ago abandoned on account of ill success.

The Lower Productive rocks make up the hillsides bordering the creek at the Furnace, the Conglomerate of XII also rising above water level for a short distance at the centre of the Nolo anticlinal, which crosses Black Lick between the Furnace and the mouth of Brush Creek, the country between being an unexplored wilderness, from which the valuable timber has in large part been cut.

In the vicinity of Heshbon, one mile and a half below the mouth of Brush Creek, the entire Lower Productive group is above water level. Three coal beds only of this series have been developed to any extent at Heshbon, these being the three lowest seams of the section; but the higher beds are known to outcrop and could readily be opened on nearly every hillside close to the village if occasion demanded it. The lower beds, being at the base of the hills, occupy a more advantageous position for mining, and together aggregating eleven feet of coal they yield all the fuel necessary for the domestic supply.

The Johnstown Cement bed has a long line of outcrop at Heshbon; and existing here as a good limestone upwards of five feet thick, it furnishes the farmer with abundance of fertilizer. Hitherto little attention has been paid to the deposit, but recently active steps have been taken to explore the limestone and to make practical use of it. The dominating rock of the Lower Productive Measures at Heshbon is sandstone, and the soil resulting from its disintegration is lean, and therefore requires constant nursing and assistance to be remunerative.

The Lower Productive Coal Measures at Heshbon are a trifle over 300 feet thick. They include in the aggregate about the same amount of coal as at Bolivar, although neither *Bed E* nor *Bed B* is so thick on the Black Lick as on the Conemaugh. But *Beds A and C* fully make up the difference, these coals at Heshbon being more than double their dimensions at Bolivar.

In the following brief description of the developments at Heshbon the rocks are considered in ascending order, beginning with the *Conglomerate of XII*, on which the Coal Measures rest, and ending with the *Mahoning Sandstone*, which rests on top of them. The object in the description is to show at what points the rocks are visible, and to identify as far as possible the various coal beds in the vicinity of the village.

The Conglomerate of XII is divided into three members along Black Lick, and in this respect corresponds with its condition on the Conemaugh. It measures at least 75 feet

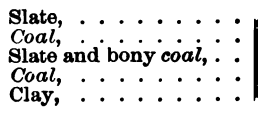
from top to base, its full thickness being perhaps slightly in excess of that figure. Its lowest member rises above the Creek below the grist mill, and is a compact, heavy, coarse grained Sandstone. *The Piedmont Sandstone*, the top layer of the deposit, is partially exposed on Mr. Hoskinson's land between the mill-dam and the village, the rock there skirting the water in a vertical cliff twenty feet high. It is fine grained, of a greenish color and much current bedded. Between this Sandstone and the lowest member of the XII occurs an interval of concealed rock, which outcrops in the bank at the mill and there fills a space 25 feet high.

Bed A. The lowest workable coal bed of the Lower Productive series here comes in almost immediately on top of the Piedmont Sandstone, being separated from the latter by a band of clay from two to three feet thick. The coal bed is exposed on Mr. Hoskinson's land and measures four feet thick; it is said to be parted near the base by a band of slate one inch in thickness.

Sandy shales and sandstone fill the interval to *bed A'*, which occurs 68 feet higher in the measures. This is the small coal seam that outcrops in the bed of the run on the A. Campbell farm to the south of the village. It is only one foot thick.

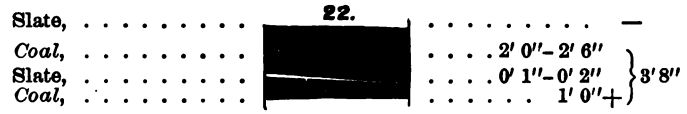
Bed B. Continuing upwards in the column, thirty feet of shales and sandy clay bring us to *bed B*, which though only three feet thick has nevertheless been quite frequently explored by the neighboring farmers. It is mined by A. Campbell, and again by J. Campbell and M. Wagner; and it is also exposed on the old Cramer property one mile above Heshbon.

In all these mines the bed is parted near the floor by a thin band of slate; it yields a tolerably good coal, which seems to be esteemed above that from any of the other beds opened in the region. The following measurement, made in the A. Campbell mine, may be taken as the average section:



Slate,	—	
Coal,	2′ 9″–3′ 0″	3′7″
Slate and bony *coal*,	0′ 1″	
Coal,	0′ 3″–0′ 6″	
Clay,	—	

Bed C is at Heshbon, a workable seam occurring 45 feet above bed B. It is four feet thick, and like both of the beds above described, it is a parted seam, but the parting is thin and unimportant. It has been explored on the P. Campbell farm west of Heshbon, being also known on the A. Campbell property to the south, at which place it is reported as 3 feet thick. Still further south, on the farm of Mr. Alcorn, it shows this section:



The Johnstown Cement seam occupies a position 45 feet above Coal C. The thickness of the limestone in this vicinity is not definitely known, but as exposed by Mr. P. Campbell, it shows five feet of rock and may be thicker.

The outcrop of the limestone has further been found on the properties of Messrs. J. and A. Campbell.

Bed D. A few feet above the limestone a trace of coal appears in the partial exposure of the deposit at the P. Campbell quarry. This coal smut represents bed D; a fuller investigation of the bed may show it to have here the same thickness as on the Conemaugh.

The Freeport Sandstone is not a conspicuous deposit at Heshbon, but it is nevertheless present, showing on the hillside at A. Campbell's immediately above Coal D. The rock as there exposed is compact and solid.

The Lower Freeport Coal, bed D′, outcrops on the P. Campbell property at an interval of 35 feet above bed D. This is the distance which usually separates these coals throughout the First Great Basin, the distance between D′ and the next higher seam, E, likewise corresponding at Hesbon to the typical interval between the same beds on the Allegheny Mountain. Nothing beyond the mere outcrop of bed D′ is known at Heshbon.

The Upper Freeport Coal, bed E, was also encountered in the explorations of Mr. P. Campbell. It occurs near the summit of the hill, seventy feet above the crop of bed D′. It is said to have a thickness of four feet.

Beyond the Campbell farm this coal shoots into the air in going north-westward, but occurs in small rounded and detached patches on the summit of Chestnut Ridge; these latter occurrences are elsewhere described in this Report.

The Mahoning Sandstone crowns the hilltops at Heshbon; it is a fine grained rock, stained with iron oxides, which give it a mottled appearance, often causing it to assume a reddish color. The slopes are quite steep to the south of the village, and are in places covered with boulders and fragments of massive sandstone emanating from the Mahoning, although they at present found far below the base of the deposit.

Brush Creek.

The ravine of Brush Creek is important as unfolding the geology of Brush Valley township. The creek heads in the high land about Mechanicsburg and flows south to meet Black Lick at Ash's saw mill, one mile and a half above Heshbon.

It is sufficiently clear from the above description of Black Lick, that the Lower Productive Coal Measures are in the hills at the mouth of Brush Creek. A portion of these rocks, however, but only a small portion of them, is there below water level, the tops of the ravine being crowned by Lower Barren Measures, in which the *Mahoning Sandstone* is prominent.

As Brush Creek is ascended the ravine grows rapidly shallower by the slope of the stream bed. This gradually conceals the Lower Productive Coal rocks as the valley becomes more and more narrow, until finally the tops of the ravine join and spread out as a wide sheet of Lower Barrens, on which the town of Mechanicsburg is built. These same rocks cover nearly the whole of the surface of Brush Valley township, by which is explained the total absence of workable coal beds, not only at Mechanicsburg, but everywhere on the uplands of this township. The sheet of Barrens extends west of Mechanicsburg nearly to the summit of Chestnut Ridge, and eastward it sweeps across the top of the Nolo anticlinal. But in the deep valleys skirting

the township on the north and south, range the Lower Productive Coal beds nearly all of which are of workable thickness.

The few developments made in the ravine of Brush Creek illustrate what has just been said with regard to its geology.

Thus two coal beds and two limestone bands have been exposed near the mouth of the creek. The lower of the coals was discovered in sinking a well on the Mock farm, and is reported as a parted seam three feet thick; it is not elsewhere known in the ravine.

The upper coal bed is mined by Mr. Ash near the mouth of the creek, being likewise three feet thick. These coals are forty feet apart. Ascending the creek to Overdorff's mill the upper seam is at water level; here also is exposed a mass of heavy sandstone which comes in almost immediately on top of the coal. This sandstone was thought to represent the *Freeport deposit* thus making the coal below, *bed D*, and the seam in Mock's well *bed C*.

Ascending the stream still higher and advancing to the Wilson property, about one-half mile above Oberdorff's mill, two limestone layers, thirty feet apart vertically, make their appearance on the left side of the ravine. The lower of these is a very ferruginous rock, which calcines only under the hardest burning and yields then an impure reddish lime. The upper stratum, likewise partially opened by Mr. Wilson, is, on the other hand, an unusually pure limestone for the coal measures; it is streaked with thin veins of calcite, and slakes down readily into a white lime.

These limestone bands were identified as belonging to the *Upper* and *Lower Freeport* deposits, neither of which coals, however, have yet been opened hereabouts. This identification is moreover further established by the presence of a heavy sandrock, which comes in a short distance above the upper limestone, and is especially prominent below Stilt's mill, and again below Stewart's mill. The sandstone belongs to the Mahoning at the base of the Lower Barren Measures.

On top of the sandstone a small bed of coal one foot thick and overlaid by black slates has been repeatedly found

in the vicinity of Mechanicsburg. This is the coal that was explored at Stilt's mill, and again on the Ross farm, where a thickness of three feet is claimed for it, although the bed is represented as "very irregular and unreliable," which subsequently led to the abandonment of all efforts to develop it.

Chapter VII.

Detailed Description of the Mines and Developments along Yellow Creek in the Ligonier Basin.

Yellow Creek crosses the Ligonier Basin in a deep valley from six to eight miles north of Black Lick, and about the same distance south of Two Lick, which latter stream it ultimately joins in the Third Basin, west of Chestnut Ridge.

Together with Little Yellow Creek—properly its south fork—it drains a considerable portion of the Ligonier Basin, receiving waters from Green, Pine, Buffington, Cherry Hill and Brush Valley townships. But it is along the borders of the two townships last named that the valley is deepest in the Ligonier Basin, and of the most importance economically, because it is there that the Lower Productive Coal Measures from top to base are above water level, and advantageously situated for mining.

Regarding the geology of Yellow Creek Valley, it may be said that while it is not exactly a repetition of that described in the last chapter, yet it is nearly so. And with respect to the points of difference, these have been effected by precisely the same causes that were explained as producing the changes in the Black Lick geology, as compared to that displayed along the Conemaugh between Laurel Hill and Chestnut Ridge. In a word, the Nolo anticlinal continues to *rise* northeast along its strike through Buffington and Pine townships, while the Chestnut Ridge anticlinal at the western edge of the Basin continues to *fall* in the same direction. The effect of this is to deepen the trough slightly at its western rim, and to render it more shallow at the centre.

The Laurel Hill anticlinal is at least 7 miles east of Strongstown, and its northwest dip is not, therefore, felt at all in the Yellow Creek region. This simplifies somewhat the geology, the valley of Yellow Creek-proper being simply a synclinal basin extending from the Nolo axis to the centre of Chestnut Ridge; but the head springs of Little Yellow Creek are outside the synclinal, being on the east flank of the Nolo anticlinal, which it cuts, and cuts deeply, before joining the main stream, whose upper waters flow lengthwise through Cherry Hill township.

Portions of the Lower Barren group of rocks everywhere cover the highlands of the region drained by Yellow Creek. These measures are there in places not entirely devoid of economic interest, of which a notable instance occurs in the Evans "Round Top," on the summit of Chestnut Ridge. At this place two small, but nevertheless workable beds of coal, appear close together near the base of the Lower Barrens (see fig. 30); but the beds, if persistent geographically, are certainly not continuous in thickness, or they would otherwise reappear either in the valley of Little Yellow Creek, below Suncliff, or in the valley of Yellow Creek proper, to the east of Greenville, both of which ravines at the places named occupy about the same geological horizon as the Round Top.

Generally speaking, however, the Barren Measure hillsides have been so little explored by the farmers that a comparison of these rocks with the condition of the same measures elsewhere is either impossible or rendered useless by the fragmentary condition of the sections. But it is, nevertheless, certain that the *Morgantown Sandstone* has disappeared from the Basin before reaching this latitude, in consequence of the increased shallowness of the trough. And the same remark applies not only to the *Black Lick ore* band, but apparently with equal force to the *Black Fossiliferous limestone*, of which no discovery has as yet been made along the Yellow Creek waters. This would reduce considerably the amount of Barren Measures in the Basin, comparing this with its condition further south.

The Mahoning Sandstone at the base of the Lower Barren

group is an important and governing rock in the Yellow Creek Valley of Ligonier Basin, particularly at the western end, along the flank of Chestnut Ridge, although it is scarcely less conspicuous at the eastern end of the trough, as for instance on Little Yellow Creek, where this is crossed by the Strongstown pike at Gillespie's mill.

The Lower Productive Coal Measures, on the other hand, have been more thoroughly investigated and explored by property holders, partly to supply the domestic demands for coal and limestone, but principally with the object of inquiring into the mineral resources of the hills bordering Yellow Creek, along which it was proposed at one time to run a line of railroad which should connect the lumbering region of the upper Susquehanna (West Branch) with the Pennsylvania railroad. A very available route was selected for this branch road, and some work was done on it, but the project has since been entirely abandoned.

The section of the Lower Productives, as exposed in the Yellow Creek Valley, (confining this to the Ligonier Basin,) is most complete on the Evans farm, near the centre of the Chestnut Ridge anticlinal. A section of equal length, and of the same rocks, could be made on Little Yellow creek, where this stream crosses the Nolo anticlinal, between Dick's Mill and Suncliff; but the latter region is a wilderness in which no explorations or openings have yet been made.

It is not proposed in this connection to analyse the Lower Productive section of the Yellow Creek Valley, because this section is so similar to those already described as occurring on Black Lick and the Conemaugh that such an analysis is rendered unnecessary. By a comparison of the sections the reader will see at a glance wherein they differ and agree.

As an instance, however, of the uniformity with which coal beds occasionally extend, presenting over and over again virtually the same section at points widely separated from each other, attention may here be directed to the remarkable similarity existing between the condition of bed B on the Evans farm and its condition at Bolivar on the Con-

emaugh, or at Porterfield's mill on Two Lick, in the Third Basin. So similar, indeed, are these three sections of the bed that any one of them might readily pass for either of the others, although a distance of at least eighteen miles separates the two most distant points, which are, moreover, situated on opposite sides of the broad anticlinal arch of Chestnut Ridge.

It would be incorrect, however, to suppose from this that the bed is identifiable generally in the Basin by any such means. Identifications of coal beds, even at comparatively short intervals, based *alone* on the similarity of mine sections, are productive of little else than confusion and error. The structure and size of coal beds often assist materially in the recognition of the same seams at different points of the Basin; but such features must only be considered conjunctively with others that always enter more or less into the problem of identification.

It is further desirable to note in this connection that the average thickness of the Lower Productive Coal Measures is about the same on Yellow Creek as on the Conemaugh, the vertical interval between beds E and A being 270 feet at the Evans farm, as against 300 feet at Bolivar.

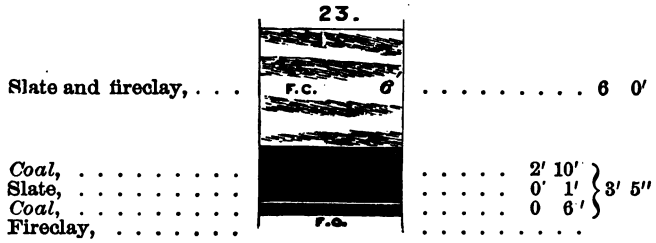
In the detailed description which here follows of the Yellow Creek Valley it is intended only to point out at what places the rocks are exposed, and where and by whom they have been developed or explored. This, it is thought, with the aid of the map, will render the location of the coal seams, wherever these are above water level, a matter easily accomplished by farmers and other property holders.

Considering first the upper waters of Yellow Creek, the main branch, as already stated, flows chiefly through a region made up of Lower Barren rocks, as far as its junction with Little Yellow Creek, in the southeast corner of Cherry Hill township. But for a short distance below its head springs—namely, until it enters Pine township—the main branch washes the upper rocks of the Lower Productive group, exposing the coal beds of this series as far down in the column as bed D. The only connected developments on the coals in this region have been made on the adjoining

properties of Messrs. Griffith and Sides, near the boundary line between Pine and Green townships.

The Nolo anticlinal runs between the exposures on the two farms, causing an opposite dip in the mines. Owing to the deflection of the Nolo anticlinal, the dips here are W. N. W. and E. N. E., and the low angles at which the coal inclines show that the anticlinal is scarcely more than a gentle wave in the rocks.

Griffith Mine. The coal at present mined by Mr. Griffith close to water level is *bed D.* It is about 3½ feet thick as here exposed, and of like dimensions where opened on the Sides farm. It yields a fuel both pyritous and slaty, but, being the only bed mined in this immediate vicinity, the coal is quite extensively used by the farmers in their houses and lime kilns. The bed shows the following section:



No investigations have been made of the strata composing the hill which rises above the Griffith mine to a sufficient height to include not only the balance of the Lower Productive Measures, but also a small portion of the Mahoning Sandstone. On the Sides farm a workable deposit of tolerably good limestone outcrops forty feet (vertically) above coal bed D. The limestone is reported as having a thickness of six feet, but only four feet of the deposit are at present exposed. The limestone is of a bluish color and carries some minute fossil shells; it is in position for the limestone stratum usually underlying the *Lower Freeport coal* (bed D′), of which traces appear in the partial exposure of the clay stratum overlying the limestone.

Bed E. From forty to fifty feet still higher in the meas-

ures a bed of coal, said to be four feet thick, was found by Mr. Sides in an adjoining ravine. This coal has never been investigated to any extent at this place, but it clearly belongs to the *Upper Freeport seam*, corresponding also in thickness to the same bed as mined on the Rupe farm further south, near the head waters of Little Yellow Creek.

The Mahoning Sandstone appears near the hill top on the Sides farm, but there makes a scanty display, being much current bedded and given to shaly structure.

Thence northwestward the Lower Productives slowly sink beneath the creek level and are lost to sight along the eastern borders of Cherry Hill township.

The country between the main branch and Little Yellow Creek is traversed by the Nolo anticlinal, carrying Lower Barren Measures on its back. This, likewise, is its condition at the village of Nolo, and workable beds of coal need not, therefore, be sought either at the last named village or anywhere along the crest of the axis in Pine township; but as the Lower Productive coals reappear in the valley of Little Yellow Creek, which flows along the eastern flank of the ridge, there is no scarcity of either coal or limestone above water level in Pine township.

This is sufficiently shown by the exposures and developments in "Irish Bottom," and again at Gillespie's mill. At the former locality only the *Upper Freeport* coal is mined, but the section deepening as the creek is descended, lower beds of the series come to daylight as Gillespie's mill is approached, while still further down, at Dick's mill, the base of the group is above water level.

The dip is southeast across the creek, along the left bank of which, as far down at least as Gillespie's mill, *the Mahoning Sandstone* is prominent, existing as a massive rock at least fifty feet thick. It shows on the Strongstown pike in cliffs and large boulders but disappears totally, going east under the Barren Measure plateau, on which the village of Strongstown is built, the last of the sandstone being seen at the Catholic Church, about $\frac{1}{8}$ of a mile west of the village. This statement sufficiently explains the absence of workable coals close to Strongstown.

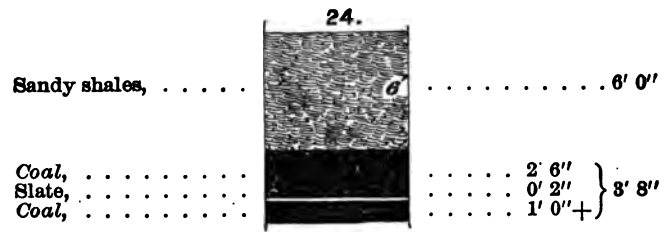
The Mahoning Sandstone is easily traced northward along the creek into the "Irish Bottom" settlement, where it overlies the *Upper Freeport Coal.* The latter seam has twice been exposed in this region, once on the property of the Franciscan friars, and again on the Rupe farm at the creek. At each place it measures four feet from roof to floor, being parted near the base by a small but persistent band of slate. It is slightly pyritous, but seems, on the average, to yield a tolerably good clean fuel.

On the Rupe farm the coal is underlaid at an interval of about fifteen feet by a band of bluish limestone, slightly fossiliferous and sufficiently pure to be used in the kiln for quarry lime.

A similar band of limestone, and thought to belong to the same deposit, outcrops on the Hogan farm to the southwest of Strongstown. The face of the quarry at this place shows the following section:

Surface,		
Slates and shales,		10′ 0″
Limestone,	1′ 0″	
Clay and shales,	1′ 4″	6′ 4″
Limestone,	4′ 0″	

Bed D. Descending thence towards Little Yellow Creek at Gillespie's Mill, a bed of coal 3′ 6″ thick and directly overlaid by a cliff of compact sandstone, 10 feet high, appears in the bank of a small run three fourths of a mile below the Hogan quarry. The vertical interval separating this coal from the limestone above described amounts to about one hundred feet, and considering this in conjunction with the exposures at the mill, the coal may be identified as *bed D* of the Lower Productive series, the Sandstone roofing it representing the *Freeport* deposit. Tracing the coal along the hill slopes to Gillespies' mill, we find it there opened on both sides of the creek, on the left bank by Mr. Cresswell, and on the right bank by Mr. McMeel, by whom it is mined and at the mouth of whose drift it thus shows:



The Johnstown Cement bed, which should underlie this coal is not here apparent on the surface, nor have any efforts been made by the farmers to find it, abundance of good limestone being obtained from the higher Freeport deposit, which has been explored on the Hill property one half mile east of Gillespie's mill.

The Freeport Limestone at the Hill quarry is by barometrical measurement 70 feet above the Cresswell mine on bed D. It is overlaid by a thin stratum of coal, to which attention has elsewhere been called, as frequently accompanying this limestone in the Ligonier Basin.

The Upper Freeport Coal at this place does not apparently exceed 20 inches in thickness, a marked contrast to its size on the Rupe farm in the Irish Bottom. It was opened by Mr. Hill, with a view to its development, but was ultimately abandoned on account of its reduced thickness.

The Lower Freeport Coal is not exposed in the vicinity of Gillespie's mill, and it does not therefore appear in the section given below. Its absence from the column must not however be understood as signifying that it is here absent altogether from the measures, the bed at this place being most probably small and easily overlooked in the imperfect exposures on the hillsides. The section extending from Nolo to the creek at the mill is as follows:



Coal smut, Philson, . .	—
Black slate, ...	10′ 0″—15′ 0″
Ferrugin's sandy shales,	25′ 0″—30′ 0″
Sandstone, massive, *Mahoning*, ...	50′ 0″
Coal, Upper Freeport,	1′ 8″— 4′ 0″
Interval, clay	8″ 0″
Fireclay shale, ...	10′ 0″
Coal smut, small, . . .	—
Calcareous clay, with nodules of limestone,	2′ 0″
Limestone clay, ...	2′ 0″
Limestone, ...	1′ 0″
Interval, ...	25′ 0″—30′ 0″
Calcareous clay, with ore lumps, ...	10′ 0″
Sandy shales, ...	20′ 0″
Sandstone, Freeport, .	10′ 0″
Coal, bed D, ...	3′ 6″
Interval, ...	15′ 0″—20′ 0″
Black slates, ...	15′ 0″
Coal, bed C, ...	1′ 6″
Creek level.	230′ 0″

Below Gillespie's mill, Little Yellow Creek cuts still deeper into the measures, bringing to daylight the base of the Lower Productive group, and even the massive sandrock (XII) on which the group rests. This occurs at Dick's woolen mill, between which point and Suncliff, the *Nolo anticlinal* crosses the valley in a deep gap made up chiefly of Lower Productive rocks. These continue along the slopes, above water level, nearly as far as Suncliff, where however Lower Barrens appear in the place of the Lower Productives, composing not only the uplands stretching southward into Brush Valley township, and northward into Cherry Hill township, but the same soft argillaceous shales fill the entire valley from Suncliff to and beyond the confluence of Yellow Creek and Little Yellow Creek.

A bed of coal six feet thick is claimed to have once been opened at water level above Dick's mill. This seam would be at or near the base of the Lower Productive group, and most likely represents *bed B*, which has a similar thickness on the Evans farm at the western end of the Basin.

Coal and limestone belonging to the same measures have also been discovered in the vicinity of the woolen mill, while lower down the creek, namely at a point about one mile above the Suncliff grist mill, Mr. Simons exposed a bed

of coal four feet thick which was directly underlaid by a band of limestone. These latter strata are probably near the top of the Lower Productives.

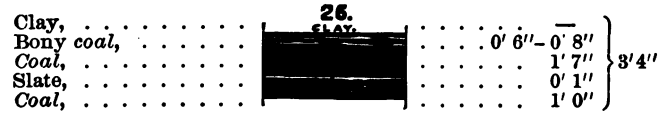
Suncliff has derived its name from an abrupt cliff of sandstone and crumbling fire clay shales, which together cap an easterly facing hill 150 feet above the water at Mr. Simon's mill. The bluff seventy-five feet high ranges along the creek as a precipitous wall for a distance of 800 feet, the fire clay shales weathering into deep holes and caverns over which hang masses of sandstone. The spot with its surroundings is quite picturesque, and is often visited on account of its natural beauty.

In descending Yellow Creek below the confluence of its upper waters, the Lower Barrens rise above the creek bed in obedience to the Chestnut Ridge anticlinal, which the stream crosses in the wilderness region between Fetterman's fording and the sharp bend to the southwest below the Evans farm.

Advancing with the description as far west as Fetterman's fording, we there find nearly the whole group, if not all of the Lower Productive Coal Measures, represented in the hills between the creek and the school house overlooking the stream from the south.

The Mahoning Sandstone is unmistakable on the hill tops. It is here a massive rock which breaks up into large cubes in weathering. It has a mottled appearance from the iron oxides it carries, although these are not present in sufficient abundance to interfere with its value as a building stone. Its outcrop is very prominent on the Mechanicsburg road, just before this begins to descend into the valley of Yellow creek.

The Upper Freeport coal appears on the Creswell property, but only as a small bed to which little economic importance can be attached. At the point exposed by Mr. Creswell it seems to almost directly underlie the Mahoning Sandstone. The bed measures thus:



If the above section be compared with that made of the same bed on the top of Chestnut Ridge, 4 miles southwest of the Creswell farm, it will be seen that the bed is reduced in this interval named to about one half its thickness at the former locality.

Bed D. Between the Creswell mine and the bed of coal worked on the adjoining property of Mr. A. J. Wilkins, there is a vertical interval of one hundred feet. From explorations elsewhere on the Wilkins farm, it has been established that the lower coal is attended by an underlying band of very ferruginous limestone, portions of which contain impressions of small univalve shells. The thickness of the limestone is not definitely known, but there is obviously a considerable amount of it. Hitherto the pieces of rock obtained at the outcrop of the deposit have mainly defied all attempts at slaking, although some fragments of good limestone have been found. Further developments are necessary to establish the precise condition of the deposit.

The coal bed mined by Mr. Wilkins has several times been exposed in this vicinity, and it seems to possess an average thickness of about 3½ feet. But in the Wilkins mine it exceeds these dimensions, showing there the following section:



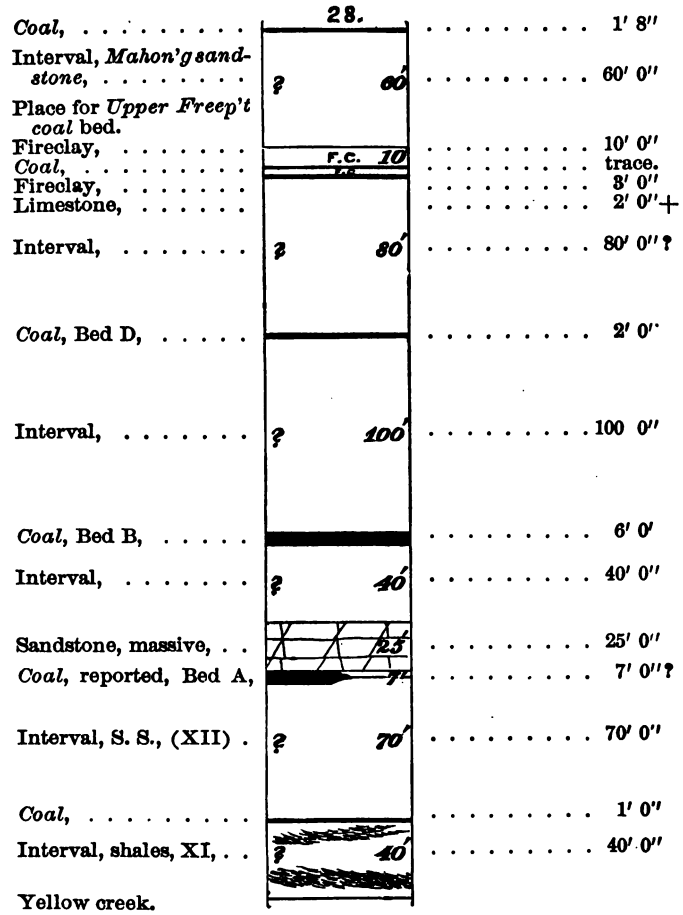
Bed B? The coal recently opened by Mr. Fetterman near the creek is said to exist as a double seam, parted by a thick interval of shale. As at present exposed only the upper bench of the bed is visible, and this measures 3′ 8″ thick. By barometrical leveling the coal is nearly on a level with that opened by Mr. Wilkins, but it is highly improbable that the two seams are identical, because this would suppose the rocks to be nearly horizontal, which the mining operations at Wilkins' and at Fetterman's clearly show they are not, and the coal at the fording, 110 above the creek, likely represents bed B.

The exposures in the *Evans settlement*, close to the Chestnut Ridge anticlinal, complete the list of exposures along Yellow Creek in the Ligonier Basin, the further consideration of the same valley below the anticlinal being resumed in a subsequent chapter.

Two long sections, embracing a part of the *Lower Barrens*, all of the *Lower Productives*, all of the *Pottsville Conglomerate*, (XII,) and a part of the *Mauch Chunk red shale* (XI) were constructed between the high land at Evans' and the creek level in the gap. One of these sections is on the E. Evans farm, and is the more direct, extending straight down a rather steep slope; the other one on the J. Evans property, at the School House is, however, more complete. This last section extends from the summit of "Round Top" past Mr. Evans' and down Turner's run to Yellow Creek. Both the sections are given below.

There is little difficulty in identifying the coals of the two sections, inasmuch as the Mahoning Sandstone affords an horizon easily recognized at both places. The two sections might thus be merged into one and discussed together, but it is believed a separate treatment of these exposures and developments will be less likely to produce confusion or misunderstanding.

The section constructed on the E. Evans property is as follows, reading downward:



447′ 8″

The small coal seam at the base of the Conglomerate is a hard, tough and compact mass of bright coal, apparently wedged in sandstone. It was sufficiently exposed by Mr. Evans to show its condition, having been opened up at its outcrop for several feet along the face of the hill.

Between this coal and *bed A* intervenes the *Pottsville Conglomerate*, seventy feet thick. The rock is made up of coarse sand compactly bedded.

The thickness of bed A is given on Mr. Evans' authority, the drift which was once run in on the seam being now closed

up. It is reported as a double seam, similar in appearance and condition to bed B.

Bed A at this place is roofed by heavy sandstone, which outcrops in a bluff near by, 25 feet high. This is one of the persistent sandrocks of the Lower Productive Coal Measures. (See chap. IV of this report.) Between this sandstone and the next higher coal, occur from 30–40 feet of concealed rocks, and it would be interesting to know if in this interval some evidence of the Ferriferous limestone of the Allegheny River region does not occur.

Bed B is the coal now mined on the E. Evans farm, close to the township road. It was first exposed on the hillslope directly above the strata last described, where it gave the same measurement as in the present mine, as follows:



Dark clay,	—	
Coal,	4′ 0	7′ 2″
Clay, hard,	0′ 6″—1′ 2″	
Coal,	2′ 0	
Clay,	—	

The coal from both benches is rendered impure by the large amount of iron pyrites scattered through it, the pyrites appearing as thin seams and flakes. The parting clay takes a wide range in point of thickness, but it rarely measures less than six inches.

It should also be noted that at this place a bluff of thin bedded sandstone appears on top of bed B, a condition of things corresponding to the exposures of this bed a few miles to the southwest, but at variance with the usual roof rocks of bed B.

Bed D. A vertical interval of one hundred feet occurs between *bed B* and the next higher seam exposed on the E. Evans property, thus passing over the outcrop of *bed C* and the *Johnstown Cement seam*, which latter should underlie the small coal two feet thick. This coal is, therefore, adjudged to be *bed D*, which has, moreover, a like thickness on Yellow Creek in the Third Basin, and is there also underlaid by its usual attendant limestone.

Neither the Lower nor Upper Freeport coals have been discovered on the E. Evans property, and they do not, therefore, appear in the section. But it is undoubtedly the *Freeport limestone* that was cut through in the well near Mr. Evans' house. This is further substantiated by the appearance of the *Mahoning Sandstone* a short distance higher on the hill, while a vertical interval of eighty feet, and perhaps as much as one hundred feet, occurs between the limestone and the small coal seam identified as D. The *Upper Freeport* coal has clearly been overlooked in the explorations for coal on both the Evans farms, but the seam occurs six feet thick on the top of Chestnut Ridge, about ¼ of a mile southwest of the Round Top.

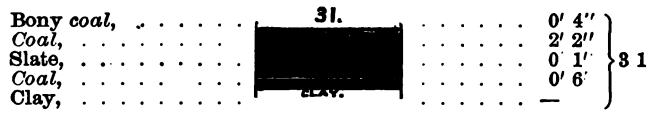
No better guide is needed to the geology of this region than the *Mahoning Sandstone.* The rock is so massive and so thick, and is so prominent a feature of every slope that includes it, that its outcrop can readily be traced from farm to farm, and across all the ravines and valleys by which this part of the Basin is intersected. In the same condition it runs across the "Ridge" and into the Third Basin.

Following now the outcrop of this rock southwestward to the Round Top, it is there overlaid by one hundred feet of argillaceous shales and thin bedded sandstones belonging to the Lower Barren group. These are the highest rocks exposed at this place on the summit of Chestnut Ridge, and are found only in the Round Top. They contain two small seams of coal, the lower of which corresponds with the highest stratum of the E. Evans section. The rocks exposed between the summit of Round Top and the mouth of Furrier's Run are as follows:

Summit, Round Top, .	30.	—
Thin sandstones and sandy shales, ...	47′	47′ 0″
Slates, ...		5′ 0″
Coal, Philson seam of Berlin, ...		3′ 1·
Interval, concealed rocks	? 50′	50 0″
Coal, reported; Gallitzin seam, ...		3′ 0′
Mahoning Sandstone, .	65′	65′ 0″
Coal outcrop; Upper Freeport, ...		1 0′+
Concealed rocks, . . .	? 20′	20′ 0″
Fireclay outcrop, . . .		—
Concealed rocks, . . .	? 40′	40 0″
Coal, bed D′, ...		2 2″
Concealed rocks, . . .	? 30′	50′ 0′
Coal, bed D, ...		1′ 6″
Concealed rocks, . . .	? 20′	20′ 0″
Coal outcrop, ...		—
Concealed rocks, . . .	? 65′	65′ 0″
Coal, bed B?		4′ 0″+
Interval, ...	? 30′	30′ 0″
Sandstone, ...	20′	20′ 0″
Interval, ...	? ?	?
Sandstone, ...	30′	30 0″
Coal, bed A, reported,		7′ 0″
Sandstone XII.		463′ 9″

The Barren Measure coals represented in the Round Top have both been opened by Mr. J. Evans, but with unsatisfactory results, the beds being much intermixed with impurities. The upper of the seams is identifiable with the Philson coal of the Berlin section,* and shows in the mine as follows:

*Report HHH, 1876, Chap. III.



The acreage of this bed is very small, occurring as it does only in the summit of Round Top. It is likely underlaid by limestone.

Gallitzin seam. The coal bed next lower in the column is reported as having a thickness of three feet. It was once opened at the outcrop, but the trial pit is now closed. It is said to be parted near the floor by a thin band of slate, and to resemble generally the bed above.

The Upper Freeport coal was accidentally exposed on the Round Top by the uprooting of a tree. To find this coal was the object of nearly all the explorations made on Round Top by Mr. Evans, but by a curious coincidence its outcrop has hitherto been invariably overlooked and neglected, while all the remaining seams of the series have been discovered. The thickness of *bed E* at the Round Top is, therefore, not known precisely, but in this respect it probably does not differ much from its condition along the top of the Ridge to the southwest of Round Top.

Where opened south of Furrier's run, the bed yields five feet of coal, parted by a thick band of shale, as on the Conemaugh at Bolivar. In places along the top of the Ridge the bed is provided scantily with cover, but again at other places it is roofed by the whole of the Mahoning Sandstone. Its outcrop was opened on the D. Stevens farm, with the following results:



The same bed has also been exposed by D. Overdorff, J. A. Findley, and V. Brown, in all of which mines it shows a section almost identical with the above. From Mr. Brown's mine (close to the centre of the anticlinal) the outcrop of the coal may be easily traced to J. Dearmy's, and

back thence along the summit of the ridge to M. Gamble's, at which place it is mined at its full thickness. Thence southwards to the waters of Black Lick the coal has been little explored, but with the aid of the map at the end of this volume, the observer will experience little difficulty in tracing the bed along the hillsides.

The Freeport Limestone doubtless accompanies its coal bed along the summit of Chestnut Ridge, but the presence of the deposit is unknown to the farmers of this region. It could be advantageously quarried and used in fertilizing the soil. It should occur at an interval of from 15 to 20 feet below the Upper Freeport coal.

The Lower Freeport coal has been found on the flanks of the Round Top, at an interval of 60 feet below Bed E. It has a thickness of about two feet; the same coal makes a small outcrop on the Findley Farm, at about the same distance below the mine on the Upper Freeport bed.

Bed D likewise shows on the Round Top, but only as a small and unimportant seam, corresponding, however, in this respect with its condition on the Shephard property, in the Third Basin, near Homer, where it is underlaid by a thin band of ferruginous limestone. This limestone very likely also accompanies the coal on the Round Top.

Bed B? The coal mined at water level on the Misses Roberts farm has been identified, with some hesitation, as *bed B*. Possibly this seam may represent *bed C*, but the former identification seems more probable in the face of all the facts that can be gathered. It is about 190 feet below *Bed E*, maintaining this interval with great persistency, as shown by the developments on the Lewis farm, and also at V. Brown's, and again on the Findley property, where it was explored many years ago, this last being among the earliest coal developments in this section of country. At all these points it is four feet thick, overlaid by sandstones and sandy shales. In places the coal from this bed is quite impure, but it seems to maintain a fair average.

At an interval of thirty feet below the coal heavy sandstone outcrops in the bed of Furrier's Run, and extends some distance down the stream. Between this rock and a simi-

lar sandstone occurring about one half mile further down the same run, there is an unknown interval of rock, the anticlinal of Chestnut Ridge crossing the stream at this place. The interval however is probably small.

Below the lower sandstone, an important bed of coal was once opened just above the water level; the coal is said to have a thickness of seven feet, being parted, however, by a band of shale. This seam clearly represents bed A and is at the base of the Lower Productive section, heavy sandstone (representing XII) coming in almost at once below the fire clay floor of the coal.



Chapter VIII.

Detailed Description of the Mines and Developments along Two Lick Creek in the Ligonier Basin.

The two main branches of Two Lick unite at the southern boundary line of Green township and together flow a south course to Mitchell's Mills (Diamondville in Cherry Hill township), at which place the creek turns from south to west and after describing an ox-bow, breaks through Chestnut Ridge and leaves the Ligonier Basin.

The geology displayed along the creek in this Basin may thus be briefly stated: Both branches start in the Lower Barren Measures, the North Branch flowing south, and the other running west towards Diamondville, where the base of the Lower Productive rocks is lifted to water level by the Chestnut Ridge anticlinal.

The creek nowhere cuts the Nolo anticlinal, its furthermost waters heading on the western flank of that ridge, which as a high water shed passes through the extreme southeastern corner of Green township, and runs thence out of Indiana County into Cambria.

Along so much of the flank of this Nolo ridge as the tributaries of Two Lick touch, no workable coal beds are displayed, that portion of the township being a gently undulating upland of Lower Barrens. Indeed it may be said of all the upland of Green township, that it presents one great sheet of Lower Barrens, feathering gradually at the sides towards the Nolo anticlinal and Chestnut Ridge.

From this it will appear that Green township, with the exception of a small strip at its western end, consists of one broad synclinal trough, the highest rocks of which belong to the Lower Barren group. The soil is mainly smooth and

good, and for the most part under cultivation; the surface is diversified by numerous shallow ravines, all of which widen and deepen westward and southward towards the main creek of Two Lick.

The South Branch drains the "Pine country," a wide plain at the eastern end of the township, and once thickly studded with valuable pine and hemlock timber, some of which still stands. The "flats," as they are locally called, are supported by the Mahoning Sandstone, here a massive rock which has a thickness of at least one hundred feet. It shows along the banks of the South Branch, rising often in abrupt cliffs from the water's edge; and at a point about abreast of Pine Flat village the whole deposit is above the creek, which brings to daylight the uppermost coal seam of the Lower Productive Measures. This is near J. Learn's mill, where the coal was once exposed four feet thick. Thence to the confluence of the two branches the Lower Productive Measures make up the base of the slopes, but the valley is chiefly a wilderness in which no developments have been made.

Rock Run is a tributary of the South Branch, and leads to Cookport, which like the village of Pine Flats is built on Lower Barren Rocks. At neither place is the Mahoning Sandstone far below the surface, the outcrop of this massive rock along the little run, having given to the stream an appropriate name. Workable coal seams need not, therefore, be looked for on the high land in the vicinity of either of the villages above named.

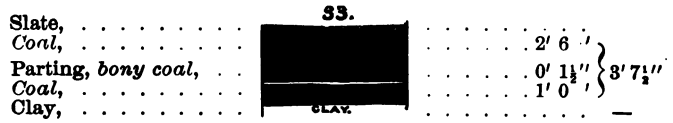
But going west from Cookport and descending into the somewhat deeper ravine of the North Branch, the Lower Productive Coals soon appear under the northwest rise of the rocks towards Chestnut Ridge, the centre of which anticlinal runs along the high land between the North Branch and Taylorsville.

The Upper Freeport coal skirts both sides of the North Branch ravine to the headwaters of the stream near the Dunkard church. The outcrop line of this coal is shown approximately on the geological map of the county at the

end of this report, which renders unnecessary any verbal description in detail of the run of the bed.

It remains however to be shown what the condition of the bed is in this region, and for this purpose the scanty developments of the North Branch valley only imperfectly answer. Such investigations as have been made are chiefly confined to the "Pleasant Valley" region, in the neighborhood of J. Buterbaugh's mill. At this place the several openings that have been made are probably on the same bed of coal which seems to maintain throughout an average thickness of about four feet. The drifts now worked are on the properties of J. Buterbaugh, Mrs. Barr, and Jos. Nickel.

At Buterbaugh's mill the rocks dip gently to the southeast, thus furnishing easy and simple drainage to the mines thereabouts. Buterbaugh's mine is on a low hill to the south of the creek. A short distance back from the mouth of the opening the following section shows:



The bed wrought in the Barr and Nickel mines one-quarter of a mile distant, and on the opposite bank of the creek is a trifle thicker, and yields a cleaner coal than is obtained from the Buterbaugh drift. Moreover the barometrical measurements show a difference of level between the mines in excess of what the normal dip would make it, and it is possible, though unlikely, that both the *Upper* and *Lower Freeport* coals are here above water level.

The Upper Freeport coal is little known at the head of the North Branch valley. Lower Barren rocks prevail along that portion of "Penn's Purchase Line" skirting the northern boundary of Green township, in which latitude the north branch of Two Lick takes its rise. Against this barren belt the outcrop of the *Upper Freeport coal*, in whatever condition the bed may exist there, turns and runs down the ravine, thus describing a wide circuit, its path being marked by boulders of *Mahoning sandstone*. Of such boulders and

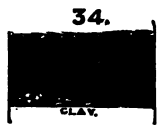
fragments there is a considerable collection in the neighborhood of the Dunkard church.

The Upper Freeport coal re-appears on the J. Meyers farm, situated about one mile northeast of Taylorsville, and close to the central line of the anticlinal fold of Chestnut Ridge. The bed is here three feet thick, but is not at present mined at this locality.

The Freeport limestone is in place twenty-eight feet below its coal bed. This interval is a slight increase over the distance usually separating these strata in Indiana County, and shows a local expansion of the rocks.

The deposit is in three layers, separated by bands of clay shale, the lime rock being itself also considerably intermixed with aluminous matter. It seems to lack the small fossil shells that are almost invariably found in the Freeport Limestone. The whole of the deposit is not exposed on the Meyers property ; but on the Huston farm, near the "Purchase Line," it appears in the bed of a small run, and is at least six feet thick.

Bed D'. At the latter place the *Lower Freeport coal* is mined 3½ feet thick, showing also on the Nupp property higher up the creek. The coal obtained from it is slightly pyritous, but not to a damaging extent, the bed supplying a large belt of country with a fuel that gives entire satisfaction. On the Huston property the section is as follows :



Slate and clay,	—
Coal,	3' 6"–3' 8"
Clay,	—

A section embracing the Freeport group of rocks was compiled from outcrops along the upper waters of the North Branch, with the following results :

Upper Freeport coal,	3' 0"
Interval,	5' 0"
Sandy fire clay,	10' 0"
Sandstone,	5' 0"
Sandy shales,	3' 0"
Black slates containing knife edge of coal,	5' 0"
Limestone and slate,	6' 0"
Interval,	25' 0"

Slates and clay,	5′ 0″
Lower Freeport coal,	3′ 6″
	70′ 6″

The Two Lick gap of Chestnut Ridge is mainly a wilderness in which natural rock exposures are rare. The height of the summit of the Ridge below Mitchell's Mills is scarcely more than 1,500 feet above mean tide, Atlantic Ocean. This is about the lowest summit of the Ridge in Indiana County, being at least 500 feet lower than the summit at the Packsaddle gap, and about 300 feet lower than the top of the axis in the northeast corner of the county, the anticlinal rising both southwest and northeast from the Two Lick gap.

The Lower Productive Coal Measures, capped by the Mahoning Sandstone, make up the sides of Two Lick gap. The Conglomerate of XII is above water level only at the centre of the arch, and is not there especially prominent, the sandstones of the Coal Measures being fully as conspicuous, and hence liable to be mistaken for the true Pottsville Conglomerate.

The developments and exposures along this part of Two Lick show two beds of coal, separated by an interval of about 250 feet. The upper of the seams is certainly *Bed E*, (*Upper Freeport,*) being directly beneath the *Mahoning Sandstone*, and having also its attendant *Freeport limestone* beneath it. The true position of the lower coal seam is rendered somewhat doubtful by the very imperfect sections, but the most probable identification makes it the lowest coal seam of the Lower Productives, namely, *bed A*. The more complete section of these rocks obtained along Penn run, near Greenville, a few miles southwest of Two Lick gap, shows nearly all the workable coal beds in these measures, together with their thickness and the intervals separating them. The same sectionis doubtless applicable to Two Lick at Mitchell's Mills.

The Upper Freeport coal is, however, exposed on the Waltemeyer farm about one mile below the Mills. This is on the right bank of the creek, and near the top of the hill. On the same slope, and at the same locality, the *Freeport lime-*

stone outcrops at an interval of from fifteen to twenty feet below the coal, the section here obtainable being as follows:

Sandstone, coarse, iron stained, conglomeritic,		20′ 0″+
Slate,		0′ 3″
Coal,	2′ 6″	
Slate,	thin.	3′ 6″
Coal,	1′ 0″	
Clay and shale,	15′ 0″	20′ 0′
Limestone.		

It is most likely also the *Freeport limestone* that is quarried on the Dick farm, on the left bank of Two Lick, nearly opposite the Waltemeyer mine. The deposit as there exposed has a total thickness of ten feet. It is quite free from impurities, calcines easily, and produces a good, strong fertilizer, which has been used by some of the farmers in the vicinity with excellent results. Limestone has also been discovered on the same property at a much lower horizon, an interval of certainly one hundred feet separating the two deposits. The pieces obtained from the lower stratum show an excellent quality of limestone, but as there is no inducement to develop the band, in view of the great thickness of the Freeport deposit, the precise condition and size of the rock is unknown. A small coal outcrop is visible in the road 30 feet above.

The lowest coal seam exposed in the Two Lick gap is 3½ feet thick, having been opened on both the Dick and Haines farms. The bed is roofed by obliquely bedded sandstone, which runs as a low cliff along the water's edge, appearing always in contact with the coal.

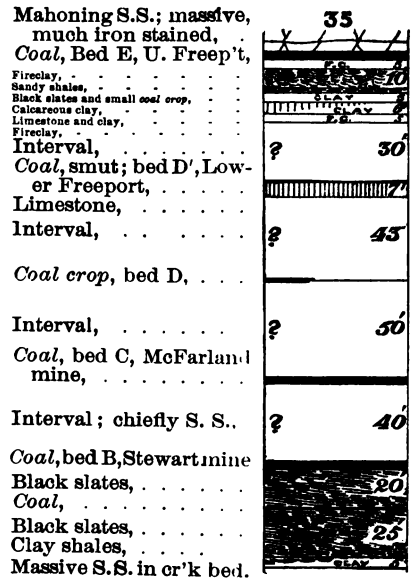
Penn Run.

Penn Run, the most important of the Two Lick tributaries, cuts through Chestnut Ridge at a point about 2½ miles southwest of the Two Lick gap. It drains the Greenville country, the town of Greenville standing at the top of the Lower Productive Coal Measures, with Lower Barren rocks exposed to the east and the Mahoning Sandstone overlooking the town from the top of the ridge which passes about a mile to the west of Greenville.

Penn Run unfolds a natural geological section beginning

at the top with the Mahoning Sandstone and extending nearly to the base of the Lower Productive group. Three coals of the latter series are mined in this vicinity, but the *Upper Freeport* (E) is the seam at present worked at the town of Greenville, being there the only bed of minable thickness above water level.

The Penn Run section as reproduced in Fig. 35 is intended only to show the relative positions of the several coal beds. Compiled from numerous local sections it is in detail as follows:

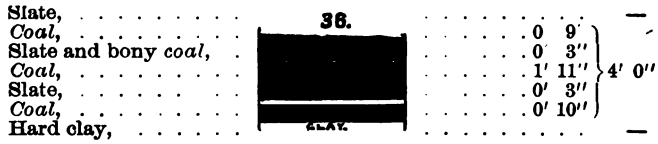


Mahoning S.S.; massive, much iron stained,	—
Coal, Bed E, U. Freep't,	4′ 0″
Fireclay,	5′ 0″
Sandy shales,	10′ 0″
Black slates and small *coal crop*,	2′ 0″
Calcareous clay,	5′ 0″
Limestone and clay,	3′ 0″
Fireclay,	5′ 0″
Interval,	30′ 0″
Coal, smut; bed D′, Lower Freeport,	small.
Limestone,	7′ 0″?
Interval,	43′ 0″
Coal crop, bed D,	—
Interval,	50′ 0″
Coal, bed C, McFarland mine,	4′ 0″
Interval; chiefly S. S.,	40′ 0″
Coal, bed B, Stewart mine	4′ 0″
Black slates,	20′ 0″
Coal,	0′ 6″
Black slates,	25′ 0″
Clay shales,	5 0
Massive S.S. in cr'k bed.	
	265 6″

The Mahoning Sandstone from its massiveness of deposit breaks up into enormous boulders along its line of outcrop. Although in places stained with iron oxides which cause it to crumble in weathering, it is yet often quite free from iron, and if judiciously selected would make a fine building stone. Its outcrop is very prominent along the top of Chestnut Ridge, but especially so on the township road connecting Greenville with Two Lick creek at Lydicks.

The Upper Freeport coal comes into the measures here

almost directly below the sandstone, the rock often forming the roof of the bed. It is much parted by persistent bands of slate which occupy the same relative position to one another that they do in the Homer region further south, although the bed at Greenville is considerably reduced in thickness as compared to its condition at Homer in the Third Basin. As already stated however, it supplies Greenville with coal, having been repeatedly opened close to the town. The average section is as follows:



The bed is in the same condition at Mr. I. Mentch's, on the Strongstown pike, two miles southwest of Greenville. The bed has further been explored on several farms south and west of Greenville, in all which mines it shows a section similar to the above.

The Freeport Limestone outcrops along the face of Chestnut Ridge to the west of Greenville; its outcrop is distinct and so plainly marked as to permit of its being easily followed from field to field by the color it gives to the soil. The deposit has here a thickness of at least six feet, yielding a bluish fossiliferous limestone which is easily and quickly calcined. The rock can at present best be seen on the Stewart farm, to the northeast of Greenville, where it is quarried by Mr Stewart, who by liberal use of this fertilizer has made his farm one of the most productive in the county.

The Lower Freeport coal is beneath the town of Greenville, but shows on the pike near Mentch's. It is probably of little practical value, its outcrop indicating a small seam; but its underlying limestone attains a thickness of seven feet in this neighborhood, having been quarried to a small extent by Mr. Mentch near the top of the Ridge.

Of coal D and its almost invariably attendant stratum of limestone (Johnstown Cement) little is known hereabouts

save of a meagre outcrop, which appears in the road near Mr. Mentch's house. The same bed forms a distinct outcrop in Mr. Stewart's fields.

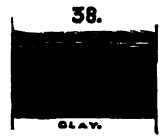
Bed C. The coal mined by Mr. S. McFarland on property adjoining Mr. Stewart on the west is the next lowest bed of the above section. (Fig. 35). By barometrical measurement this bed is fifty feet below coal D. It is overlaid by sandstone and rests upon clay ; it yields rather impure coal, carrying both slate and pyrites in considerable quantities. A full section of the bed is as follows :



S. S.,		—
Slate,		1′ 0″
Bony *coal*,	0′ 5″	
Coal,	3′ 0″	4′ 1″
Parting, chiefly pyrites,	0′ 1″	
Coal,	0′ 7″	
Clay,		—

Bed B. Descending thence one half mile northeast to Penn Run proper, we find a bed of coal very similar in appearance to the above, opened on the farms of Messrs. Stewart and Ober. Between the coals, however, the barometer indicates a difference of level amounting to forty feet, the interval space consisting largely of heavy sandstone.

It has been supposed that these coals represent a single horizon, but such an identification is impossible in view of the interval separating them, unless the fall in the anticlinal in this distance is equal to forty feet. The Stewart and Ober coal has, therefore, been identified in the above section as belonging to bed B, and thus corresponding with the seam once opened on the Empfield property, near the mouth of the run. This latter seam certainly underlies the bed mined by Mr. McFarland. In the Ober mine the following measurement of the coal was obtained :



Slate, tough,		—
Coal, bony,	0′ 4″	4′ 0″
Coal,	3′ 8″	
Clay,		—

Like all the coal mined in this region, that from bed B is pyritous. It has, however, been largely used in the lime kilns, and is said to be a strong fuel.

Black slates underlie the seam at Empfield's, extending nearly to water level; below these slates sandstone appears, the sandstone being obviously the deposit overlying coal A, which latter bed, therefore, is here concealed below the run.

CHAPTER IX.

Detailed Description of the Mines and Developments along the tributaries of the Susquehanna River in the Ligonier Basin of Indiana County.

The northeast corner of Indiana county, that is to say, nearly all of Banks, the whole of Montgomery, and a small portion of Green townships is drained by several small streams which flow eastward into the Susquehanna river.

North of "Penn's Purchase Line" (a line running nearly west across the county from Cherry Tree,) Chestnut Ridge is the water shed between the Susquehanna and the Ohio; south of the "Purchase Line" the water shed is represented by a narrow belt of high land running southeast from the Dunkard church as far as Cookport, where it turns almost due east, and skirts Cushian creek to and across the Cambria county line.

The area thus embraced is in great part a wilderness, in which the Lower Productive rocks cover the surface and fill the little valleys, which are here and there, however, capped by a thin sheet of Lower Barrens. This is a striking contrast to the condition of the Basin not only along the Conemaugh, but as far north as Two Lick, and shows to what extent the depth of the trough has been reduced.

The valley of Cushian creek in the northeast corner of Green township is of little economic interest, being confined to a region of Lower Barren rocks until near the town of Cherry Tree, where the Upper Freeport coal in workable condition appears above the water level.

The Mahoning sandstone is the chief feature of the valley. As a massive rock composed of coarse sand, it skirts both sides of the creek far above its mouth. The base of the deposit rises above the stream bed at McKeag's mill, in

which vicinity the rock is especially prominent, extending to the top of the slopes, and covering the surface with huge angular boulders of sandstone.

The outcrop of the Upper Freeport coal runs up Cushian Valley as far as McKeag's mill, going under water level just above this point. The bed is mined at several points along the Susquehanna river close to the town of Cherry Tree. These mines were described in the Report of Progress for 1875, and in this connection it is necessary only to say that the bed is four feet thick, parted twice by small slates, and yields a moderately good coal, Mr. McCreath's analysis of a specimen from this vicinity showing in 100 parts a trifle over of 1 per cent. of sulphur and about 5 per cent. of ash. Moreover the coal is underlaid at a short interval by its usual attendant limestone, which however has been but little explored along the upper waters of the West Branch.*

Cush Creek.

Cush Creek is an important stream draining nearly the whole of Montgomery township, and a considerable portion also of Banks township. It flows in a deep valley which forks near its head, both branches extending to the village of Gettysburg and there starting in rocks at the base of the Lower Barren column. Nearly the whole of the valley is unimproved timber land; its mineral resources are confined to the coals, limestones and fire clays of the Lower Productive Measures; its soil is lean and the country rugged because these rocks hold several heavy sandstone deposits; and it is on account of these sandstones that the farmers and early settlers made their "clearings" and founded their settlements in the smoother uplands.

At the village of Gettysburg there are few natural or artificial rock exposures. The limestone that outcrops in Mr. Ake's fields to the west of the village belongs apparently to the Lower Barrens, no workable coal bed having yet been found there, nor does any such likely occur above water level at Gettysburg.

But on the Clark property two miles north of the village,

* See Report H H.

a bed of coal four feet thick is exhibited at the base of a hill on which boulders of the *Mahoning Sandstone* extend downward nearly to the mine. If the lowest of these sandstone masses indicate the base of the Mahoning deposit, then the coal is obviously the *Upper Freeport*, but from indications further down the creek it is believed that the bed exposed at Clark's is identical with that mined by Mr. Barkey, which is unmistakably *bed D*.

Mr. Barkey's mine shows 4′ 4″ of coal, including however a mass of bony coal 0′ 5″ thick, which appears directly under the roof rock. At the mouth of the mine, the coal is overlaid by thin bedded sandstone, instead of which at Clark's there is a stratum of sandy ferruginous shales of about the same thickness; the show of coal at both places is about the same.

The Clark and Barkey mines are near the centre of the Chestnut Ridge anticlinal which passes scarcely more than a mile west of these developments. The gradual but gentle rise in the rocks, is sufficient to elevate the coal worked by Barkey to the top of the highest land at Mr. W. G. Walker's. From this last place the anticlinal runs through the Gorman settlement, and on thence nearly under the village of Smithport; along its central line in this interval are several mines and exposures, which are elsewhere described in this Report.

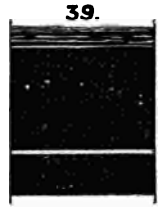
At the point where the Smithport and Gettysburg road crosses Cush Creek, about two miles below the Barkey saw mill, the creek flows over massive sandstone, above which, towards the west, rises a hill three hundred feet high and terraced to its top. The sandstones in the Creek are at or near the base of the Lower Productive group, a section of the hill revealing four beds of coal, one of which has been opened near the house of Mr. J. R. Smith. It was identified as belonging to *bed D*.

The Upper Freeport coal is little known throughout this region, but is found in connection with the *Freeport limestone* on the farm of Mr. M. Urey, about 2½ miles E. N. E. of Smithport. At this place it is unusually thick, as will be seen by the section given below. The *Mahoning Sand-*

stone outcrops in great abundance at the church, a short distance west of Urey's, preparatory to shooting out into the air near the centre of the Chestnut Ridge anticlinal.

The Upper Freeport bed is handsomely displayed in the Urey mine, being there operated for the supply of the country side with fuel, the fuel extracted from this mine being quite free from injurious impurities, and much esteemed in the neighborhood. Both benches of the bed yield equally good coal, the showing in the Urey mine being perhaps as fine as is anywhere presented by the Upper Freeport bed in the Bituminous Coal Region. This is certainly the case with respect to the thickness of the seam which on the Urey property will yield, acre for acre, as much coal as the Pittsburgh bed. How far it may extend in this superb condition is a question easily determinable, but at present is of little practical interest to the farmer. Doubtless at some time, and perhaps at a day not far distant, the bed will receive from capitalists the attention it fully merits.

As far as developed by Mr. Urey the bed is both persistent and regular, being overlaid by tough slate, which furnishes the seam with a secure, even roof, that acts also as an impassable barrier to percolating waters. All of the coal is not now taken up by Mr. Urey, only two feet of the lower bench being exposed. The section in detail is as follows:



Grayish slate,	—	—
Coal, bony,	0′ 8″	
Coal, good,	5′ 4″	8′ 4″
Parting, clay,	0′ 4″	
Coal,	2′ 0″+	

Northeast of the church is the wilderness drained by *Bear Run*, which cuts down deep into the measures, exposing the whole group of Lower Productives in the sides of the ravine. A coal bed three feet thick is reported as occurring close to water level in the neighborhood of Neill's Mill.

Southwest of the church the same rocks are again crossed in descending to Cush Creek. Close to the latter stream a bed of coal (probably bed B) upwards of five feet thick, is mined on the Bracken farm. On the opposite side of the creek the road ascends (chiefly over sandstones) 270 feet to Mr. Sawyer's house which seems to be near the top of the Lower Productive measures, and workable beds of coal and limestone may be looked for in the ravines to the south of New State Road, and close to Mr. Sawyer's house.



PART III.

THE BLAIRSVILLE BASIN IN INDIANA COUNTY.

CHAPTER X.

General Description of the Topographical and Geological Features of the Basin.

The Third or Blairsville Basin is a simple synclinal fold extending without structural complication of any kind from the centre of the Chestnut Ridge anticlinal on the southeast to the centre of the Indiana anticlinal on the northwest. It is the prolongation southwestward of the Third Great Basin of Clearfield and Jefferson counties where its boundary lines on the east and west are the same as those above mentioned; but continued still further southwestward across the Conemaugh into Westmoreland county, these limits of the trough are maintained only as far as Sewickley creek, in which latitude it unites with the next basin to the west as already fully described by Prof. Steven son in his Report of Progress for 1876.*

The Basin stretches diagonally nearly through the centre of Indiana county. Narrowing somewhat towards the northeast in consequence of the non-parallelism of the two enclosing anticlinals, its width is reduced from seven miles on the Conemaugh to scarcely more than four miles in the latitude of the county seat; traced thence still further north its width is subsequently increased by the divergence of the same lines to about five miles, which is then maintained

* Report K K, p. 19.

without variation from the headwaters of Two Lick and Little Mahoning to and across the Jefferson county line.

The dips approaching the synclinal from the southeast and northwest are not always of the same force, nor does this axis run along a line situated exactly midway between the enclosing anticlinals, as would otherwise be the case if the forces exerted on both sides of the trough had been the same. In the present instance, however, though the movements were simultaneous they were very uneven, which has resulted in thrusting the synclinal eastward or westward from the centre of the Basin, as the case may be, and has given rise to conditions that are at present of considerable economic importance. Take for example the presence of the Pittsburg coal bed in the hills overlooking Blairsville. The point where this bed touches the country is five miles from the centre of the Chestnut Ridge anticlinal, and only a mile and a half from the Indiana anticlinal; and the reason why the outspread of the bed westward from the synclinal is here reduced to such narrow limits, is not because of the topography of the country, but because the southeast dips from the Indiana anticlinal correspond in sharpness to the comparative shortness of the interval over which they are felt. It is difficult to make persons unaccustomed to geological thought appreciate the force and extent of such dips, and the causes sometimes produced by them. That the Pittsburg coal bed should *overshoot* the summit of Chestnut Ridge at the Packsaddle by nearly a thousand feet, and that the great sandrock forming the romantic cliffs at Oakes Point should *underlie* the streets of Blairsville by the same amount of interval—these and many more facts of a similar nature seem so simple as scarcely to require an explanation; but for the lack of their proper appreciation by property holders much vain and fruitless search has been expended, especially along the flank of Chestnut Ridge for what cannot possibly be found there.

The synclinal axis of the Third Basin runs under the centre of the town of Blairsville, which, as before stated, is only a mile and a half distant on a direct line from the Indiana anticlinal; it is next seen in the same relative posi-

tion on Black Lick, which it crosses above the mouth of Muddy Run; next it passes to the west of Homer; keeps east of the Crooked Creek waters, whence northeastward it continues to creep slowly towards the east as the western anticlinal gains in strength, until at Robertsville, on the Little Mahoning, it is very nearly at the geographical centre of the Basin. All along this line, and on both sides of it, the floor of the trough has a very gentle but steady slope towards the southwest, a tilt which this synclinal has in common with all the similar axes in the county. The geological effect of this incline, though scarcely perceptible over small areas, is very manifest if we regard the condition of the N. E. and S. W. ends of the Basin in Indiana county. These changes are followed step by step in subsequent chapters, and additional comment here is unnecessary.

The *Chestnut Ridge anticlinal*, bounding the Basin on the southeast, is elsewhere described in this report.

The Indiana anticlinal, the northwestern limit of the Third Basin in Indiana county, crosses the Conemaugh River at Deep Hollow near Snyder station, on the West Pennsylvania R. R., 1½ miles below Blairsville; the Black Lick Creek at the mouth of Grey's Run, just above the big bend that turns Black Lick southward into the Conemaugh; it cuts Black Lick township lengthwise nearly in half; crosses the Cherry Run valley in Centre township, and then runs almost directly under the county seat, to reappear much strengthened on Crooked Creek, which it crosses at the mouth of Rayne's Run, one mile above Kintersburg; it is next felt along the highlands in the southeast corner of East Mahoning township, between Deckers Point and Marion, beyond which it makes a wilderness of the Little Mahoning Valley for a short distance, crossing this at Enterprise, one mile above Richmond; then it runs diagonally through Canoe township, crossing over into Jefferson county at a point about five miles southeast of Punxsutawney. Beyond this, through Jefferson, Clearfield, and into Elk county, it was traced in 1874 by Mr. Franklin Platt, and was by him identified as the Third Axis

of the southern counties, but probably "the Fourth Axis of the north."* It also corresponds with the axis that was described by Prof. Stevenson under the name of the Blairsville anticlinal of Westmoreland county, in which latitude it expires.†

Connecting all the numerous exposures of this axis in Indiana County, it makes a perfectly straight line for the anticlinal from the Conemaugh River to Jefferson County, the course being N. 33° E. Regarding the axis from southwest to north-east it steadily increases in force and strength until it lifts the "Elk" or "Boon Mountain" in Elk County. In Westmoreland County it is little more than a feeble undulation, across which nearly the whole Lower Barren group sweeps in an unbroken sheet. Advancing to the Conemaugh Valley, only the Philson coal seam is there lifted to water level, at an elevation of about 900 feet above the sea. These conditions are repeated on Black Lick, whence northeastward, through Black Lick, Centre and White townships, only Lower Barren rocks are exposed either along the centre of the anticlinal or in the stream beds. But the rise of the axis finally pushes these rocks to the hill tops, and in the bed of Crooked Creek, at an elevation of at least 1,200 feet above the sea, (barometrical measurements,) we see only a small amount of Lower Barrens at the centre of the anticlinal, and then only at the hilltops, the Lower Productive group inclining at angles of about 5°, there making up the slopes for a short distance. Further on only the Mahoning Sandstone crowns the arch in the highlands between Deckers Point and Marion, while in the valley of the Little Mahoning, at an elevation also of about 1200 feet above the sea, (barometrical measurements,) *Formation XI* (the Mauch Chunk Red Shale) is lifted to the day. Beyond this in Canoe township Lower Productive measures usurp the places of the Lower Barrens, and make up largely the country rock in that region; but even these in time also disappear from the centre of the anticlinal, though not before reaching Elk County, where

* Report H, pp. 15, 16, 142, 143.
† Report KK, pp. 13, 14.

the *Pottsville Conglomerate* (XII) crowns the summit of the "Boon Mountain," along which the axis runs.

The course of the axis in Indiana County is not specially marked by any distinctive topographical features; generally speaking, it traverses a high rolling country, broken here and there by shallow ravines, until it approaches the region of the Lower Productive Measures, when the hills fall more into line, but not sufficiently so to enable the axis to be traced from point to point by the topography.

In an economic sense the Third or Blairsville trough is surpassed by none in the County. And for purposes of agriculture and grazing it is certainly the equal of any other region in the district. Its southern portion is amply supplied by the Upper Productive Measures with coal and limestone, while its northern part is no less liberally provided with the same material above water level by the Lower Productive Measures.

Iron Ore, understanding thereby only workable beds of ore, is very scantily represented in the rocks of this Basin. There is, of course, no lack of "ore nodules" and "balls" in extensive beds of shale, but these being ecomically valueless, deserve no special consideration. At one locality on Yellow Creek the indications for a small but continuous supply of good carbonate ore are very promising.

Fire clay and building material can be obtained in prodigious quantities above water level in this Third Basin. The Black Lick brick works have acquired deserved celebrity; and the massive condition of the Mahoning Sandstone along Yellow Creek and Two Lick renders that rock of considerable importance to the builder.

Both the Conemaugh and Black Lick cut the basin transversely from end to end, thus furnishing a complete section of all the measures included in the trough, at its deepest part in Indiana County. Beginning at the water's edge at the centre of the Chestnut Ridge anticlinal in Packsaddle gap, and ascending to the summit of the highest land at Blairsville, the basset edges of nearly 2200 feet of rocks are crossed. From this a very correct estimate may be made of the character and thickness of the rocks that will be pierced by the

proposed oil drilling near Blairsville. These rocks, beginning with the Catskill group and ending at the top with the Upper Productive Measures, are fully described either in previous or subsequent chapters of this Report.

Chapter XI.

The Upper Productive Coal Measures in the Blairsville Basin of Indiana County.

The Pittsburg coal bed, accompanied by a small amount of the Upper Productive Coal rocks, crosses the river from Westmoreland County at Blairsville, to stretch thence northeast along a narrow zone at the synclinal or central line of the trough, to and across the valley of Black Lick, the Basin finally terminating in a small rounded knob, beyond which, and as far north as we may choose to go, not a trace of this coal or these measures can be found.

Their disappearance from the Basin, going northeast, even in spite of a slight increase in the general elevation of the surface in the same direction, is caused by the gentle, and in places scarcely perceptible rise prevailing along the central line of the trough, which though gentle and subordinate to the normal inclines towards the northwest and southeast, is nevertheless sufficient not only to force these Upper Productive rocks into the air, but to finally bring to the surface further to the northeast, measures that at Blairsville are hundreds of feet below the river bed. Towards the southwest the effect of the same movement is equally apparent, but of course is the opposite of that observed to the northeast; at Coketon, for example, opposite Blairsville, the Pittsburg coal bed barely sinks beneath the drainage line, and then only for a short distance at the centre of the Basin, while still further south the same coal can only be reached at the synclinal by deep shafts.

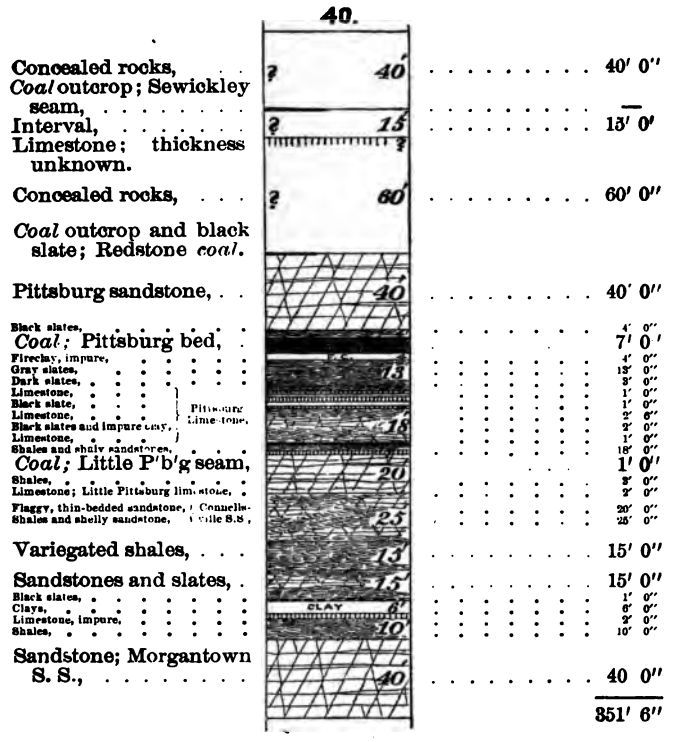
The greatest length of the Blairsville area of Upper Productive Coal rocks, or, in other words, the furthest point to the northeast at which the Pittsburg coal can be found in

this Basin, is about five miles; its *greatest width* is about one mile; and if the area thus compassed were still covered, as it once was, by a continuous and unbroken sheet of these measures the Basin would possess considerable economic importance. But having occupied for ages the highest land in the trough, and having therefore been subjected to the ceaseless action of the eroding agencies, it has been broken and cut into a number of areas of variable dimensions, all of which taper off towards the northeast until the Basin ends in a point.

The ravines separating these areas are usually shallow and narrow, the only exception to this being the valley of Black Lick which crosses the Basin in a deep and irregular cut, extending far down into the Lower Barren Measures, and separating the two coal areas nearest the creek by an interval of fully one mile on an air line; otherwise the areas are close together being divided in some cases by the width of only a single field.

Occupying only the highest land, the geological structure and position of these rocks, namely at the centre of the Basin, necessarily confines them to a narrow zone; any rise, however gentle, from the synclinal towards the respective anticlinals must draw sharply the boundary lines on the northwest and southeast, inasmuch as the topography of the Basin, consists in general terms of a wide flat of Lower Barrens, on which is raised a line of low smooth hills composed of Upper Productive rocks. Around these hills runs the irregular outcrop line of the Pittsburg Coal bed, as shown on the map at the end of the volume.

At the deepest part of the Blairsville Basin it holds about one hundred feet of Upper Productive rocks. The highest stratum recognizable is the *Sewickley coal bed*, which in one place is overlaid by forty feet of rock. Thence the section extends downwards into the Lower Barrens as far as the *Morgantown Sandstone*, which is exposed both at Blairsville and Campbell's mill on Black Lick. The section in detail is as follows:



The most important member of the above section, in an economic sense, is, of course, the Pittsburg coal bed, which is also regarded as the base of the Upper Productive group. Of this coal there is only a comparatively small amount represented in the Blairsville area, notwithstanding its apparently great extent. If the smaller areas, or little islands of Pittsburg coal, could be joined and compressed into one solid and continuous sheet, they would scarcely cover one and a half square miles of territory. Now allowing six and a half feet (and this is the maximum) as the average height of the bed in this region, or say 10,000 tons to the acre, there would be in gross in this entire area *at the most* 10,000,000 tons of coal, of which a considerable amount must be deducted for outcrop coal, and considerably more for loss in mining, so that of available and marketable fuel

from the Pittsburg bed in the Blairsville region 7,500,000 tons is, perhaps, the outside figure.

This estimate is roughly made and makes no pretension to positive and absolute accuracy, but is close enough to show the general value of the Basin.

Of the character and condition of this coal, as well as of the thickness of the bed and the extent of its partings, the reader can judge from the analyses and sections given further on in this chapter.

After what has been said it will require no elaboration to show that the Blairsville area of Pittsburg coal possesses little economic importance excepting to the immediate section of country in which it occurs. There is too little of the coal, and what there is is too impure to render the region deserving of the attention of capitalists; but as a large seam, most advantageously situated for mining, it will supply the Blairsville country with a cheap fuel sufficiently good for domestic use for a long time to come. And it will further serve to calcine the limestones, of which there is an abundant and ample supply interstratified with the rocks both of the Upper Productive and Lower Barren groups.

Nothing whatever is known of the condition of the *Sewickley* coal bed in this Basin. But indisputable evidence of its existence here occurs in the form of two abundant outcrops; the one being on the farm of Mr. R. Smith, about one mile north of Blairsville, and the other on the Doty property, at the extreme northeast end of the Basin across Black Lick Creek. At both these places the coal is caught only in the top of a cone-shaped knob, and at neither of the localities is there more than a single acre of the bed represented. Its outcrop darkens the soil of the fields at an interval of from 115 to 120 feet above the Pittsburg coal, which corresponds very closely with the vertical interval prevailing generally between these horizons throughout the southwest, and especially with the distance separating them in the Salisbury Basin of Somerset County.

In the immediate vicinity of the town of Blairsville the hills are not high enough to include this coal.

The Sewickley limestone has a somewhat wider range than

its coal, which it underlies at an interval of fifteen feet. It is this rock that caps the Coleman knob overlooking the valley of Black Lick. It is likewise the *Sewickley limestone* that Mr. Smith quarries 100 feet above his mine on the *Pittsburg coal;* and it is also this rock that makes so conspicuous a limestone outcrop in the township road above the G. Doty mine.

Its thickness in this region has never been definitely ascertained, because in the work thus far done by the farmers, only the upper layers of the deposit have been quarried. These strata yield, however, an abundant supply of excellent limestone, semi-crystalline, of a brownish cast, fossiliferous, easily calcined, and producing good fertilizing material. At some points the rock is bare on the surface, and at others again it has considerable covering; but under any of the conditions in which it appears in this Basin it will amply repay the cost of quarrying, being composed generally of much purer limestone than any of the other deposits above water level.

An analysis of a specimen taken from near the top of the deposit, as exposed on Mr. Smith's property, gave the following results to Mr. A. S. McCreath:

" Carbonate of lime,	79.821
Carbonate of magnesia,	8.601
Oxide of iron and alumina,	8.020
Sulphur,	.117
Phosphorus,	.018
Insoluble residue,	12.160 "

The small coal outcrop that appears on the Smith farm, 38 feet above the top of the Pittsburg bed, clearly belongs to the *Redstone seam.* It makes here, however, so feeble a show, and at all the other points in the Basin where it should occur, it is so obscure that there need be little hesitation in pronouncing the bed small and of trifling importance in an economic sense. But its recognition is of interest, especially as it is found occurring at its usual interval of about 40 feet above the Pittsburg bed.

The Pittsburg Sandstone entirely fills this interval of forty feet between the Redstone and Pittsburg coals

throughout the Blairsville region, coming in here almost directly above the Pittsburg coal, in some instances there being only a few inches of shale between the two. But this proximity has not in the least injured the great coal bed so far as the seam has yet been developed.

The Pittsburg sandstone is very handsomely displayed in a line of vertical cliffs skirting the right bank of the Conemaugh river at Blairsville. These connected cliffs have obtained the name of "Alum hill," from the small quantities of this substance blossoming out of the rock in a tender and flaky effloresence; it is in consequence of this slow oxidation of the sulphides existing in the sandstone that the rock has the peculiarly pitted or honeycombed appearance we see, especially at the base of the deposit, a short distance above Mr. Sloan's coal bank.

Excepting a small portion, and that at the base of the stratum, the sand composing this rock was deposited in swiftly running currents. Its oblique bedding is in fact the most conspicuous feature of the stratum, the planes of deposition meeting each other at various angles in separate unconformable groups. It is owing to this structure that the Pittsburg sandstone makes so little display in the fields over which it ranges, appearing only as thin fragments, and never as large blocks and boulders.

The thickness of the Pittsburg sandstone in this region corresponds to its dimensions in the Saltsburg basin further west. And it seems further to retain this thickness of forty feet with astonishing persistency along the synclinal of the Blairsville trough south-west of the Conemaugh. Mr. Ford, Supt. of the Millwood Coal Company, informs me that this is its thickness in the Millwood shaft, and Prof. Stevenson shows with what regularity these dimensions are maintained across the Youghiogheny and as far south as Uniontown. But Prof. Stevenson also shows in his Report of Progress for 1876, how the Sandstone in other localities occasionally expands to twice this thickness and even more.

The *Pittsburg coal bed* throughout the entire Blairsville area yields a coal of inferior quality. This is sufficiently shown by the analyses made by Mr. McCreath from speci-

mens carefully selected to represent the average condition of the bed at different parts of the region. And these analyses only serve to confirm the unfavorable impression obtained from an examination of a variety of hand specimens from all the principal mines.

The seam runs about six feet thick, occasionally expanding to seven feet, but quite as often dropping below the average. At the town of Blairsville, and within the area enclosed by the Conemaugh and Black Lick, the bed is parted unevenly into two benches, by a thin and unimportant band of slate; but north of the Black Lick the bed is *twice* parted, each time by mere knife edges of clay, that prevail, however, with great persistency, maintaining uniformly the same position in all the mines, and constituting, therefore, regular partings of the bed.

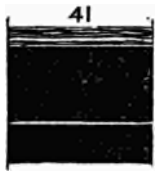
As before stated, the coal bed is here so advantageously situated that little skill is required in mining it. It breaks down easily under the pick, coming out in large compact blocks that bear transportation well, but which owe their firmness and compactness in a considerable measure to their slaty composition. The roof is universally good, even where the Pittsburg Sandstone is in contact with the coal; the floor is no less even and quiet, and horsebacks or disturbances of any kind are comparatively rare in this Basin.

In keeping above water level throughout the entire area, it renders the drainage of the mines, when properly opened, a matter of no difficulty whatever; and its outcrop line being almost invariably marked by a high, evenly rounded and plainly discernable bench on the hillsides, there is also no difficulty in finding the coal wherever it exists. It has, therefore, been opened on nearly every farm through which it passes, some of the openings being quite extensively worked, while others again not being needed have been deserted and are now closed.

Crossing the river from Coketon, the coal overshoots Blairsville, but is caught in the bluffs and hills to the east of the town. Going east along the main street through Blairsville the bed is first seen at Mr. Maher's house, on the outskirts of the town, where it makes a very distinct

outcrop, being roofed by several feet of slates, over which the Pittsburg sandstone appears and makes the top of Cemetery hill.

Tracing the coal south to the river it is opened on the property of Mr. T. Sloan, a few hundred feet east of the township road and nearly opposite the Coketon ovens. It has here a fine roof, being protected by the entire Pittsburg sandstone, and the coal is dry and firm in all the entries and gangways of the mine. The following section shows the height of the bed at this place, and the subjoined analysis from a specimen selected from the dump at the mouth of the mine, express plainly the character of coal here obtained:



Dark clay and bony *coal*,	. . . . . 1′ 0″	
Coal, ...	. 3′ 8″–3′ 10″	5′ 11½″
Slate, ...	. . . . 0′ 1½″	
Coal, ...	. 1′ 10″–2′ 0″	

The analysis of the coal gave the following figures. (A. S. McCreath):

"Water,	.850
Volatile matter,	27.385
Fixed carbon,	49.748
Sulphur,	3.017
Ash,	19.000
	100.000
Coke per cent.,	71.765
Color of ash,	Gray."

Mr. McCreath adds the following description of the specimen submitted to him:

"The coal has a deep black lustre; it is rather compact, and carries numerous thin bands of slaty coal, and a large amount of iron pyrites in thin knife edges."

Beyond the Sloan mine the bed skirts the river bank (going north) for about one mile when it makes a sharp bend to the northwest, to run again across the pike at Mr. Ray's, and continue thence past the Rev. Mr. Hill's to the Lightner property on the Indiana Branch railroad, where

it again curves and runs back to Mahers. This is the largest of all the areas in the Blairsville region.

The Indiana Branch R. R. at Smith's station is in the Lower Barrens, just below the Pittsburg coal, thus breaking at this place the continuity of the outcrop line of that bed, which however again appears on the slopes a few hundred yards to the west of the station, being there opened and more extensively mined than at any other point in the region. These are the Smith and Turner mines, already worked for a number of years and supplying a large local trade. Besides the pointing out of the synclinal to the northeast, the bed is here rising also gently to the northwest towards the Indiana anticlinal, to finally shoot out into the air on the Repine farm one mile west of Smith's station.

In the Smith mine the bed shows some little variation both in thickness and character from its condition at Sloan's. When at its full height it is a trifle thicker than at the latter place, and what is more important it carries less sulphur and slate, although at Smith's it is not especially distinguished by its freedom from impurities.

In the section given below (Fig. 42) a small wedge of coal appears between the roof slates and the main bench of the bed. This was likewise observed at the Sloan mine, but does not appear at Doty's across Black Lick Creek, having thinned out and disappeared before reaching that place. It seems to belong to the roof slates rather than to the bed itself. The section in detail is as follows:



Slates and clay,	—	
Coal,	thin.	
Impure clay and slate,	1′ 0″	
Coal,	3′ 9″–4′ 0″	6′ 5″
Slate, soft,	0′ 1″	
Coal,	1′ 6″–2′ 4′	
Slate and clay,	—	

The specimen selected for analysis from the main bench of the bed, as exposed in Mr. Smith's mine, is described by Mr. McCreath as having "a deep black lustre generally, with numerous bands of bright crystalline coal running

through it. It is rather compact, and shows considerable slaty coal in thin seams."

The analysis in full is as follows:

"Water,	1.130
Volatile matter,	28.895
Fixed carbon,	56.409
Sulphur,	2.571
Ash,	10.995
	100.000
Coke, per cent.,	69.975
Color of ash,	Gray, red tinge."

West of the Smith hill is the McCrea area of *Pittsburg coal*, which, as before stated, extends as far west as T. Repine's, embracing also a portion of the latter farm. To the southwest of this are two small outlying patches of coal, one on the S. McCrea farm, and the other on the property of J. Wiley. On all these properties the bed has been explored and found to maintain its full thickness.

The bed is further mined on the Coleman farm, the outcrop of the coal crossing the township road close to Mr. Coleman's house, and again re-crossing it just beyond. The bed has here risen 55 feet from its level at Smith's station, thus indicating a very gentle slope, Coleman's house being about one mile north of the railroad at the point named.

On the Coleman property it overlooks the waters of Black Lick flowing 245 feet below. In this interval are exposed the *Connellsville* and *Morgantown* sandstones, besides two thin bands of limestone, but no coal of importance occurs here in the Barrens between the Pittsburg bed and the water's edge.

Crossing Black Lick and ascending the northern slope of the valley, the Pittsburg bed first appears in a small knob on the Campbell farm at the summit of the slopes. Here it is exposed. Then in a knob of similar size, but separate and distinct from the Campbell outcrop, and to the northwest of the latter farm, it again appears. But the most important area north of Black Lick Creek is that embracing the Doty and J. Dixon farms, which with a small outlier in the S. Dixon property terminates the Basin.

The coal as opened on the Doty farm is 55 feet higher in

level than at Coleman's; this being nearly along the strike of the rocks expresses the gentle rise in the synclinal towards the northeast—the rise that thrusts the Pittsburg coal from the Basin and covers the country beyond with Lower Barren rocks.

In the Doty mine the coal is very uniform and regular, and is decidedly more free from pyrites than where exposed at any other point in the Basin. It carries, however, considerable slate, especially near the floor, the bottom bench being almost worthless in its lower part.

The section reads thus:



Slates,	6′ 0″–8′ 0	
Coal,	3′ 5′	7′ 0″
Slate,	thin.	
Coal,	0 3″	
Slate,	0′ 1′–0′ 2″	
Coal,	1′ 10″	
Coal, bony,	1′ 4″	
Clay,	—	

The specimen selected from the main bench of the bed gave the following results to Mr. A. S. McCreath, Chemist of the Survey:

"Water	1.370
Volatile matter,	29.130
Fixed carbon,	58.461
Sulphur,	.849
Ash,	10.190
	100.000
Coke, per cent.,	69.500
Color of ash,	Gray, red tinge.

The coal is compact, with deep black lustre generally; it carries numerous bands of bright crystalline coal, also some slaty coal, with some iron pyrites disseminated in minute crystals throughout the mass."



Chapter XII.

The Lower Barren Measures in the Blairsville Basin.

The rocks of the Lower Barren group overspread a large part of the surface of the Third or Blairsville Basin of Indiana County. Along the Conemaugh they are seen in all the bluffs westward from the mouth of Tom's run; they fill the valley of Black Lick from below Bell's Mills to its junction with the river; as high forbidding bluffs they skirt the right bank of Two Lick for miles; and they make the line of low hills, that stretching northeast along the base of Chestnut Ridge, constitute the smooth and fertile uplands of Burrell, Black Lick, Centre, White, Cherry Hill, Rayne and Green townships. North of the "Purchase Line," that is, in Grant, Canoe and Banks townships they are little represented, being confined in that section to isolated patches at the centre of the trough.

But their disappearance from the Basin is gradual. Little by little, as the country rises, their area is diminished and their depth grows steadily less. So great, however, is the uniformity of the strata composing this series that little or no change is discernible in the area occupied by them either with respect to the topography of the country, or the character of its soil, until the Mahoning Sandstone, the great basal rock of the group, is brought to the surface. Then the change is as immediate as it is thorough and complete; instead of rolling uplands covered with productive soils, there are wide spread flats of sand and clay; and in place of broad and shallow valleys with the easiest and smoothest of slopes, there appear wilderness ravines with precipitous walls of massive rock.

In consequence of the Basin-shaped structure of the re-

gion, nearly every member of the Lower Barren group outcrops twice in the river hills between the mouth of Tom's Run at Livengood's, and the Deep Hollow two miles below Blairsville; another double outcrop of the same rocks occurs along Black Lick between the mouth of Two Lick and the mouth of Grey's run; additional exposures of these measures may further be found to the northeast in all the little valleys opening towards Two Lick and Crooked Creek; and though short sections may be made at these localities that are tolerably complete and *together* represent every horizon in the Lower Barrens, yet these fragments, some of which are more than one hundred feet in length, are valueless except to show in a general way the lithological character of this group. As elsewhere stated the difficulty here consists simply in the impossibilty to join these sections properly together. The group is too extensive and its recognized stable horizons are at present too few to permit of the compilations that are easily possible in either of the Productive Coal groups. This difficulty will, in time, disappear, and during the present Survey considerable strides have been made in that direction, but the work is yet far from complete.

Excepting in a few favored localities (and Indiana County is this respect cannot be regarded as such) the Lower Barren rocks offer little or no inducement to the farmers and other property holders to explore them for their mineral contents.

Along the Indiana Branch railroad, which starts in Lower Barren rocks and never leaves them, there are some fine exposures, especially near the town of Blairsville. But in no instance is there a bed of coal of workable thickness among the rocks, nor of one even approaching those dimensions. Opposite Homer, the hills on the west bank of Two Lick have been explored and picked over again and again, and the unsatisfactory results obtained should satisfy the property holders of that region that there is no coal of any value *above water level* on the west bank of the creek.

What naturally deceives the farmer in dealing with these

rocks, and acts as an *ignis fatuus* to him in his explorations, is the repeated occurrence, within short intervals, of small seams of coal. These, he thinks, of course, will, if pursued far enough under the hill, lead him to a valuable deposit; but in this supposition he has invariably found himself to be in error in the Third and Fourth Basins of Indiana County. The whole of the Barren Measure region has here not yet been fully explored, and under such circumstances, it is unwise to generalize much about the condition of the rocks. But after a very careful and minute survey, it is impossible to overcome the impression that west of Chestnut Ridge, in Indiana County, the Lower Barrens are valueless, excepting for their limestone strata, and of this kind of rock there is a plentiful abundance scattered all through the group.

By roughly connecting the exposures at Homer and Blairsville, it is certain that at least five small coal seams occur in the Lower Barrens of the Blairsville basin, and this list most probably does not include the *Philson* and *Gallitzin* beds at the base of the group. This, then, would make seven coal beds between the *Upper Freeport* and the *Piltsburg*, and likely enough the number would be increased, if the rocks were better exposed. No attempt, however, will here be made to compare the Third Basin section with that at Berlin in Somerset County, because the connections between the disjointed fragments at Blairsville and Homer are too uncertain to permit of satisfactory results being reached by any such comparison. But that the relationship between the coals at these two widely separated places is both intimate and close is certainly beyond all doubt.

One fact however seems to remain constant throughout all the apparent local variability of the strata, namely that the aggregate thickness of the group, wherever we can come at a close approximation to this, is nearly the same. The opportunities for such a measurement at Blairsville are not good, because the *Upper Freeport coal* arches across the Indiana anticlinal under the river bed; but the minimum thickness of the group in this region is certainly not less

than 500 feet, and the maximum thickness does not exceed 600 feet. These figures, though not exact, are yet close enough for comparison, especially as they correspond so closely with what was obtained on Black Lick and in the Saltsburg region to the west. Moreover, they agree with the results of the repeated measurements of these rocks in the Salisbury Basin of Somerset county, where the Lower Barrens have a total thickness of 550 feet.

A section of the Lower Barren rocks as they are at Blairsville for nearly two hundred feet below the Pittsburg coal, has already been given (Fig. 40, page 157). A section of similar length and embracing the same rocks, but made in the Black Lick Valley between the Campbell farm and Rankin's mill, may here find a place, and will be found interesting for comparison. It reads as follows:

Pittsburg Coal,		——
Interval rocks,		60′ 0″
Dark clay,		4′ 0″
Limestone, bluish, good,		3′ 0″+
Interval,		28′ 0″
S. S. Connellsville S. S.,		25′ 0″
Coal,		0′ 6″
Clay,		2′ 0″
Limestone,		2′ 6″+
Sandstone and shales,		15′ 0″
Red shales,		5′ 0″
Concealed,		37′ 0″
Sandstone,		5′ 0″
Concealed,		8′ 0″
Red shales,		3′ 0″
Sandstone,	Morgantown S. S.,	10′ 0″—15′ 0″
Red shales,		7′ 0″
Sandstone,		10′ 0″—15′ 0″

Both the Conemaugh and Black Lick sections show the *Connellsville* and *Morgantown* sandstones very handsomely, and at the distances which these rocks usually occupy below the Pittsburg coal bed. These sandstone deposits constitute important horizons in the Lower Barren group. They run with great persistency throughout Indiana County and can be recognized wherever the land is sufficiently high to include them, and they likewise form important features in the Saltsburg region further west.

The Connellsville Sandstone at Blairsville is a thin bedded, shaly deposit, little disposed towards the formation of cliffs. It therefore makes little display at this place, but is finely exposed in a cut on the Indiana Branch railroad, just outside the limits of Blairsville.

The Pittsburg limestone, twenty feet below its coal, is an important stratum throughout the Blairsville region. It is separated into three layers, which together aggregate nearly five feet of good stone. The stratum has a wide range throughout Southwest Pennsylvania, and extends eastward across the Allegheny Mountain into the Cumberland Basin of Maryland, showing also in the Salisbury basin of Somerset County.

The Little Pittsburg Coal bed, though invariably thin and of no economic importance, is nevertheless a widely outspread member of the Lower Barren group, and constitutes one of the most persistent horizons of this series. Prof. Stevenson found it to prevail with great persistency in Greene, Washington, Fayette and Westmoreland Counties; it is present also at Ligonier; in the Salisbury Basin it is equally conspicuous, and at Blairsville it is always found where its horizon is exposed. It may be seen along the cliffs to the south and west of Blairsville, and again appears at Smith's Station, showing there in a railroad cut. It is about one foot in thickness in this neighborhood, sometimes expanding to eighteen inches, but rarely exceeding this. It is here separated from the Pittsburg coal by an interval of 45 feet, thus corresponding very closely to the condition of things both at Ligonier and Salisbury.

Moreover it is usually associated with a band of limestone, that in the Blairsville Basin is separated from the coal by a few feet of soft clay shale. This limestone, known under the name of *Little Pittsburg limestone*, seems to have a range coextensive with its coal.

The Morgantown Sandstone is much more massive than the Connellsville, and hence more conspicuous. It is the Morgantown Sandstone that forms the cliff on which rests the eastern abutment of the Blairsville bridge; and it is the same sandstone that runs up the narrow ravine at the rear

of the Seminary, making the low walls of rock there, whence westward it extends as a line of cliffs along the Conemaugh. It is also exposed at water level below Rankin's mill on Black Lick, and most likely the same rock crowns the highlands opposite Homer. Its thickness at Blairsville is 40 feet.

The Green Fossiliferous limestone comes into the measures a short distance beneath the *Morgantown Sandstone*, and occupies a position about midway between the *Upper Freeport* and *Pittsburg* coal beds. It is an invaluable horizon because of its persistency, and when fairly exposed it is unmistakable. Its outcrop is obscure at Blairsville, or was overlooked in the very imperfect rock exposures on the Conemaugh below the Morgantown Sandstone. Nor was it recognized on Black Lick, but it makes its appearance on the highlands opposite Homer. At this latter place it has a thickness of about 3 feet, being underlaid by a thick stratum of red shale, below which is a band of impure argillaceous iron ore. A close measurement between the outcrop of the limestone and the outcrop of the Upper Freeport coal gave 280 feet as the interval.

Of the *Black Fossiliferous Limestone*, occurring still lower in the group, little was seen in the Blairsville region, and it certainly has never been developed in that section. Prof. Rogers speaks of it as occurring one mile northeast of Indiana on the road to McKee's mill. "It is thinner than usual and covered by red and variegated shales; it yields no good lime."* It was also seen on Crooked Creek near the Armstrong County line, and at other points in the Saltsburg Basin, mention of which is made on other pages of this Report.

The Mahoning Sandstone is so massive a deposit in the Blairsville Basin that when it is forced to daylight it usually covers the surface with large boulders of rock. For particulars regarding its character and condition the reader must be referred to the detailed chapters.

On the Conemaugh River it goes below water level on

* Final Report vol. II, p. 589.

a northwest dip at the mouth of Toms Run; passes far underneath the town of Blairsville; rises only in part above the river on the arch of the Indiana anticlinal, to descend again at once under the town of Livermore.

It is this rock (but the upper part of the deposit only) that makes the nearly vertical river cliffs at Deep Hollow, two miles below Blairsville; it is no less prominent along the western flank of Chestnut Ridge and along Two Lick, as for example at Two Lick Mills, where it makes the valley a wilderness for miles. Still further northeast it is plainly recognizable on the Mahoning waters.

Its thickness underneath Blairsville can only be estimated; for the outcrops along Toms Run furnish little opportunities for measurement, while to the west below the town, as just stated, only the *Upper Mahoning*, that is the highest of the three layers into which the deposit is here sub-divided, is lifted to daylight on the back of the Indiana anticlinal. But the entire deposit from top to base has a thickness of at least 150 feet at Blairsville, the *Upper Mahoning* alone representing 50 feet of this. On Black Lick and Two Lick its dimensions are certainly as much as 150 feet, and sometimes slightly in excess of that figure.

Moreover, at the Deep Hollow the *Philson coal seam* outcrops directly underneath the *Upper Mahoning*. It is there exposed for a hundred yards and more in the face of an extensive rock cutting along the old canal. This coal outcrop has hitherto been supposed to represent the *Upper Freeport seam*, but the supposition is erroneous, the latter coal having been found recently in an oil well at a depth of nearly 100 feet below the river, the interval consisting of heavy sandrock.

The Philson coal is divided into three layers, the lowest of which is underlaid by a stratum of limestone as at Berlin. The three layers together yield over three feet of coal, but the bed is rendered economically worthless by its thick partings of clay. The section including the Upper Mahoning is as follows:

Massive sandstone, Upper Mahoning, ...	50′ 0″
Slates and shales, ...	8′ 0″

Coal, ...	Philson coal.	. . .	1′ 3″
Black slates and clay shales, ...		. . .	6′ 0″
Coal, ...		. . .	1′ 6′
Clay, ...		. . .	2 0″
Coal, ...		. . .	1′ 0″
Fire clay, ...			2′ 6″
Limestone, ...			5′ 0″+
Interval, beneath river bed, to *Upper Freeport coal*, 75–100′			0″

The Upper Mahoning is here very massive and heavy, often conglomeritic, but chiefly a fine grained mass of grayish-white sandstone. Prof. Rogers thus describes the lithological changes which the rocks undergo at this place: "In the exposure, which is several hundred yards long, the rocks exhibit striking changes of character: thus at one point the shale under the sandstone is 10 feet thick, but in a few yards becomes a sandstone, which rests immediately upon the coal. The shales between the coal-seams thicken and thin variously. At one place where this appearance presents itself, the coal seemingly terminates in the sandstone. Near the place where these disappear with a W. dip beneath the water level, the massive sandstone, resting on the coal, changes wholly to shale for a thickness of 12 feet; the sandstone then presents a vertical wall, 40 or 50 feet thick, in coarse grey massive strata, with irregular lines of deposition along the canal."*

* F. R. vol. II., p. 600.

Chapter XIII.

The Lower Productive Coal Measures as developed along the western flank of Chestnut Ridge between the Conemaugh River and Black Lick Creek.

The consideration in detail of the Lower Productive Coal Measures in the Third Basin north of the Conemaugh may properly be prefaced with a brief statement calling attention to the great uniformity existing between the Third Basin section of these rocks and the general or typical section of the same measures across the Chestnut Ridge anticlinal, in Ligonier Valley. In point of fact, the Third Basin, so far as it relates to the Lower Productive Coal Measures, is virtually a reproduction of the Ligonier Valley, just as the Second or Ligonier Basin is in this respect but a repetition of the First Great Trough enclosed between the Allegheny Mountain and Laurel Hill.

And this resemblance extends even to the most minute details; there is not a single regular feature of the Ligonier Valley section that is not present in the Third Basin, nor is there a feature of any prominence in the latter trough that cannot be found in the Second. The same coal beds, limestones, sandstones, iron ores, and clays; separated by nearly the same intervals, and together aggregating the same total thickness—these are briefly the general results of the survey of the Third Basin of Indiana County.

The rocks of this group and the relationship they bear in general to one another are so fully described in Chapter IV that any further discussion of the subject, excepting to show the variations that the coal beds and other strata locally undergo, is unnecessary.

It should, however, be mentioned that no trace of the great *Ferriferous Limestone* of the Allegheny River region was anywhere found in this Blairsville Basin, unless we choose to regard the carbonate iron ore under Bed B on Black Lick as evidence of the limestone horizon. But *as a limestone* it is certainly nowhere developed in this Basin between the Conemaugh River and the Jefferson county line, and if it existed here as such it would certainly long ago have been found on the flank and summit of Chestnut Ridge, where the rocks at the base of the Lower Productive group have been thoroughly explored by the farmers in search of fertilizing material for the lean and cold soils prevailing in that locality. A narrow line can be drawn across the map to indicate where this limestone is and is not; we know that it appears on the western flank of the Indiana anticlinal, and we know equally well that the upheaval of this axis was long subsequent to the formation of the rock, so that this movement of the earth's crust had nothing whatever to do with defining the limits of the limestone stratum. But it nevertheless seems in the highest degree probable that somewhere in the neighborhood of that subsequent line of disturbance the limestone as such terminates, and if it exist at all to the east of this, and there is good reason to believe that it continues as an indistinct but yet recognizable horizon, it exists so far as we now know only as an unreliable deposit of carbonate iron ore. In the Third Basin of Indiana county the geologist is still wholly dependent on natural exposures, often very imperfect, for his vertical sections, and it is always possible in such cases that small deposits of limestone may be passed over in short intervals of concealed rock, but the one fact nevertheless remains even in spite of this, that the limestone stratum can here have little thickness; and can also possess little economical importance, or it would scarcely have escaped the vigilance of the farmers for so long a time.

The most important limestone stratum of the group in this Third Basin is perhaps the *Johnstown Cement bed* which is exposed again and again along all the principal streams, and can be traced northeast along the summit of

Chestnut Ridge in Grant and Banks townships. And throughout all this distance its overlying coal bed, that is bed D of the Lower Productive series, never fails to make an appearance whenever its horizon is above the drainage line. It is not the most reliable coal seam of the Third Basin, but it is generally of workable thickness and in reasonably good condition.

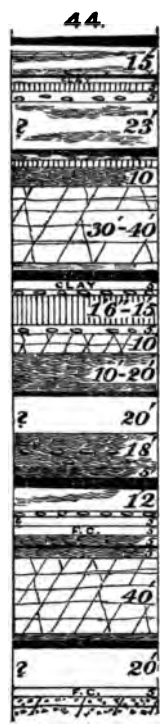
How much of the surface of the Basin is covered by the Lower Productive Coal rocks, the map at the end of the volume will show at a glance. In the latitude of Blairsville, and as far north as Black Lick, these measures are confined to the eastern edge of the trough, that is to say, to the summit and flank of Chestnut Ridge. Inclining rather sharply to the northwest they pass quickly under the Barren Measure highlands that stretch far up the slope of the Ridge, and west of Toms Run they are not above water level in Burrell Township, in which section they cross the Indiana anticlinal far below the river bed in a broad symmetrical arch. The *Upper Freeport coal*, the highest member of the Lower Productive group, is nearly six hundred feet below the town of Blairsville, or at a level of say about 400 feet above mean tide, Atlantic Ocean; yet this same seam is thrust into the air before reaching the summit of Chestnut Ridge, and if it had been spared on the bluffs overlooking the river at Packsaddle, it would there have a level of at least 2,300 feet above the same datum.

The western flank of Chestnut Ridge between the Conemaugh and Black Lick, is furrowed deeply by a number of small ravines, in the sides of which, outcrop, either in whole or in part the rocks of the Lower Productive system. This topography renders easily accessible every coal bed of the series, and opens up the vast stores of fuel along the flank of the Ridge. Beyond the needs of the farmers, however, the beds are not mined.

Only the summit of the Ridge and a small part of the surface between the ravines has been cleared of timber, and is under cultivation. The shallow soil and the exposed elevated position are alike unfavorable to agriculture. The heavy sandstone boulders and fragments emanating from

the *Conglomerate of XII*, and from the *Mahoning* at the top of the group, make a wilderness of the ravines in which there is very little timber left of any value.

The following section compiled from numerous outcrops will show the general condition of the rocks in this Basin:



Coal. Upper Freeport (E,)		3′ 6′–6′ 0″
Clay with bands of S. S. and slate,	15′ 0″	
Coal,		1′ 0′
Clay,	3′ 0″	
Limestone. Freeport Limestone,	5′ 0″	
Clay and ore, (often absent,)	5′ 0″	
Interval, slates and shales,	23′ 0″	
Coal. L. Freeport: D′,		1′ 6″–4′ 6″
Slate and clay,	2′ 0″	
Limestone,	3′ 0″	
Shales,	10′ 0″?	
Sandstone, Freeport, S. S.,	30′ 0″–40′ 0″	
Slate and clay shale,	0′–3′ 0″	
Coal, bed D,		1′ 6″–5′ 0″
Impure clay,	3′ 0″–5′ 0″	
Iron ore usually wanting,	0′ 3″	
Limestone, Johnstown Cement bed,	1′ 6″–15′ 0″	
Impure clay with ore balls,	3′ 0″	
Calcareous micaceous sandstone,	10′ 0″	
Slates and shales,	10′ 0″–20′ 0″	
Coal, bed C,		0′ 6″–1′ 6″
Interval,	20′ 0″?	
Shales with ore,	18′ 0″	
Shales, sometimes S. S.,	2′ 0″–5′ 0″	
Coal, bed B,		4′ 0″–6′ 0′
Clay shales,	12′ 0″	
Iron ore; see Black Lick Section,	3′ 0″??	
Interval,	5′ 0″	
Fireclay,	5′ 0″	
Shales,	5′ 0″	
Coal, bed A′,		1′ 0″
Shales,	5′ 0″	
Sandstone,	40′ 0″	
Black slates,	1′ 0″–3′ 0″	
Coal, bed A,		4′ 0″
Interval,	20′ 0″	
Fireclay, good,	5′ 0″	
Conglomerate of XII,		
		339′ 3″

The Lower Productive coal rocks are imperfectly exposed in the Conemaugh bluffs above the mouth of Toms Run. *The Upper Freeport coal bed* has, however, been exposed on the Livengood farm, close to the point where its outcrop line touches water level. This is about 2½ miles on an air line E. S. E. of Blairsville.

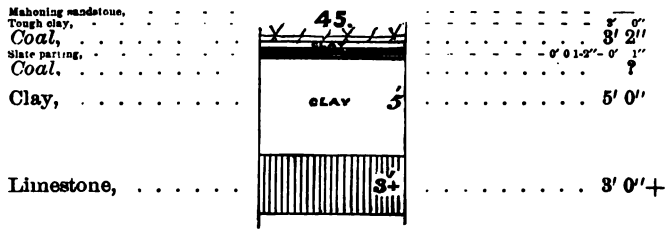
The bed here has only been partially exposed, the lower bench of the seam remaining in the floor of the mine. In view of the exposures of the same seam further to the northeast, the lower bench is likely to be small and unimportant at Livengood's.

The coal is soft, bright, of columnar structure, and apparently quite free from injurious impurities. A small band of bony coal near the base of the main bench runs through the mine with great persistency.

The limestone reported just below the mine is only five feet below the coal; it is said to have a thickness of three feet so far as yet explored; it is of a bluish color and teems with impressions of minute fossil shells. A specimen of the rock obtained at the outcrop of the deposit gave the following results on analysis (A. S. McCreath):

" Carbonate of lime,	54.768
Carbonate of magnesia,	8.627
Oxide of iron and alumina,	6.930
Sulphur,	.112
Phosphorus,	.017
Insoluble residue,	27.230 "

The section, as here exposed, of the Upper Freeport coal and limestone reads thus:



There is here an evident reduction in the interval usually separating the Upper Freeport coal and limestone. This irregularity is, however, merely local.

A few hundred yards southeast of the above exposure occurs a deposit of limestone claimed to be ten feet thick; it is further reported to be underlaid by a thin but persistent stratum of carbonate iron ore, the thickness of which is given as eight inches. Both the ore and limestone have been worked at this place. The deposit undoubtedly represents the *Johnstown Cement bed*, and in its unusual thickness corresponds to the condition of the same stratum on Black Lick, opposite Bells Mills.

At an interval of 60 feet below the base of the limestone is found a small bed of coal which belongs near the base of

the group, and is *probably bed B.* The lowest seam of the series, *Bed A*, is concealed along the river bank, but ascending the flank of the Ridge its outcrop can be traced nearly to the mountain top. There it outcrops at the base of a small rounded knob, occupying a position near the edge of the abrupt slope and between 800 and 900 feet above the Conemaugh flowing through the gap. This rounded knob is Oakes Point, from the top of which is obtainable a fine view of the rolling upland country at the base of Chestnut Ridge.

The "Point" is benched to its top. It seems to contain over a few acres three coal beds in a nearly horizontal position. One of these beds, three feet thick was once opened at an elevation of 170 feet above the waters of Oakes run at McGowan's house, where the *Conglomerate of XII* is conspicuous. This coal seam is *bed B* of the series, *bed A* appearing about 60 feet lower in the measures, while a higher seam (probably D) shows near the top of the Point at the foot of a distinct bench 90 feet above the old mine. Behind the Point, towards the east, rises the *Conglomerate of XII* covering the crest of the mountain for a short distance along a narrow line.

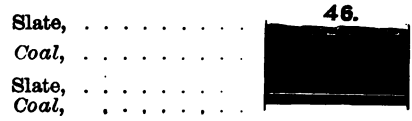
Advancing now northeast as far as D. Repine's house, close to which passes the centre of the Chestnut Ridge anticlinal, the crest of the mountain is coal bearing, although only scantily covered with these rocks. Repine's is about a mile back from the river, the anticlinal having fallen in this distance sufficiently to permit of an accumulation of coal rocks on the summit of the Ridge. The conglomerate is however here close to the surface, and the fragments of thin bedded sandstone seen just east of Mr. Repine's house may, perhaps, belong to XII, although it is not so indicated on the map accompanying this report.

In the high knob on the D. Repine farm has been exposed a bed of coal three feet thick, capped by slate and resting upon clay. The bed is clean and without persistent slate partings; three feet is its maximum thickness so far as it has yet been developed. It is very likely the same bed that was once opened on Oakes Point.

To the northeast of the Repine farm is the deep ravine down which flows the main branch of Toms Run, a stream that with its tributaries drains a considerable portion of the west flank of the Ridge, between the Conemaugh and Black Lick.

In this ravine the *Conglomerate of XII* is exposed both above and below Muir's old saw-mill. Its outcrop forms an irregular elliptical area, caused by the run starting in coal rocks, then cutting below these, but getting again into them a short distance beyond in consequence of the dip being greater than the slope of the run bed. The sandstone is abundantly scattered over the slopes, and forms a high cliff on the north bank just above the old saw-mill.

On the Thompson farm at the head of the run, a bed of coal has been opened at a level of 1891′ (by barometer) above mean tide, Atlantic Ocean. The coal is here of importance only as a means of local supply. It is worked close to the pike, and thus shows in the mine:



Higher on the "round top" at Thompson's is an outcrop of coal indicating a bed 50 feet above that worked. Possibly it is this upper seam that has been opened by Mr. Cobus, one mile to the east. The measures are here nearly horizontal. The outcrop of the Cobus coal crosses the pike above the Thompson mine, between that point and Mr. Cobus' house. When fully developed it is a trifle thicker than that mined by Mr. Thompson, as the following section will show:



The Cobus mine is very close to the centre of the Chestnut Ridge anticlinal, but to the west of that axis, the meas-

ures having in the mine an extremely gentle dip to the southeast. On the Meaner farm, ¾ of a mile west of the Cobus mine, the rocks have a decided dip to the S. E. The bed of coal once opened by Meaner probably corresponds with that now worked by Mr. Cobus.

Descending the main branch of Toms Run to the property of Mr. P. Brown a bed of coal underlaid by limestone has been exposed a few feet above water level. This coal was with some hesitation identified as *bed D*, making the limestone stratum the equivalent of the *Johnstown cement bed.* Possibly the coal represents the *Lower Freeport seam* (*bed D'*), but the developments and exposures are too imperfect to permit of this question being satisfactorily answered. The presence of the thick stratum of slates above the coal makes the latter identification very plausible.

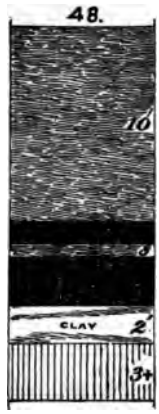
The bed is parted by a thick band of slate which injures the seam considerably. It yields a tolerably good coal, so far as appearances go. It has never been worked at this place to any extent, the outcrop of the bed having alone been exposed.

The limestone rests close beneath the coal, an interval of only two feet separating the strata. Merely the top of the deposit is now uncovered, but as much as 7 feet of good stone are claimed to have once been exposed here. A specimen of the rock was forwarded to Harrisburg for analysis, the results of which were as follows (A. S. McCreath):

"Carbonate of lime,	82.321
Carbonate of magnesia,	8.021
Oxide of iron and alumina,	2.630
Sulphur,	.102
Phosphorus,	.017
Insoluble residue,	5.502"

The limestone is of a dark color, compact and hard; it produces a reddish lime from the large amount of iron contained in it.

In full the section as here exposed is as follows:



Slates,		10′ 0″
Coal; soft,	1′ 2″	4′ 4″
Slate,	0′ 6″–0′ 8″	
Coal,	2′ 6″	
Slate and clay,		2′ 0″
Limestone,		3′ 0″+

Probably it is the same coal bed that is exposed on the Kerlin property one mile southeast of Brown's. It is there also about four feet thick, the parting slate, however, being reduced to 3 inches. Recent explorations here have shown limestone beneath the coal.

Indications of at least one higher seam than that worked by Kerlin are found above and to the west of the mine. The outcrop of the same bed was likewise observed on Brown's hill. It represents one of the Freeport seams, and probably the upper of the two.

The Mahoning sandstone is very distinct along the Bolivar road west of Mr. Kerlin's house, and also on the pike below Brown's. It is here very massive, often coarse grained, slightly iron stained, and in weathering breaks up into large blocks.

The Upper Freeport coal, roofed by a tall cliff of Mahoning Sandstone, is mined in a small way on the Snyder farm, about one half mile below Brown's. A few yards beyond the mine the coal disappears under water level, dipping at an angle of 4°.

The bed, though small, is in superb condition, yielding a coal of unusual purity. But judging from the exposures and developments on Wier's Run to the north, it is not likely that this rare state of excellence is maintained for any great distance. This will be seen by comparing the analyses given below.

In the mine the bed shows this section at Snyder's:



S. S.,			
Slate,		5′ 0″	
Coal,	3′ 0′		
Slate,	0′ 1″		3′ 7″
Coal,	0′ 6′+		—

The section of the Upper Freeport seam at Ragar's, on Wier's Run, one mile northeast of the Snyder mine, shows no material variation from the above so far as the coal is concerned. But it shows in addition the fire clay deposit that here immediately underlies the coal.

A considerable amount of this clay was once raised for the fire brick works at Bell's Mills, but the deposit is not now worked.

The specimens of coal selected for analysis from the *Upper Freeport seam* in this locality were taken from near the centre of the upper bench. The results obtained are as follows, analysis No. I representing the condition of the bed on the Snyder farm, and No. II being the analysis of the specimen from the Ragar mine (A. S. McCreath):

	I.	II.
Water,	.770	.600
Volatile matter,	27.800	26.531
Fixed carbon,	67.537	61.525
Sulphur,	.718	.629
Ash,	3.175	10.715
	100.000	100.000
Coke, per cent.,	71.430	72.869
Color of ash,	Cream.	Gray.

I. The coal is generally bright and very tender, the fresh fracture showing numerous oblique polished faces.

II. The coal is rather firm and compact with dull lustre, being considerably coated with a thin film of iron oxide. On fresh fracture the lustre is black shining to dull resinous. It carries numerous thin bands of slaty coal, and shows little pyrites."

On the opposite side of Wier's Run from the Ragar mine, limestone has been discovered on the Kelly property, but was never thoroughly opened up there. It is most likely the outcrop of the *Freeport limestone*, having been exposed at a sufficient distance southeast of Ragar's mine, to account for the difference of elevation between the two, the measures here rising sharply to the southeast. Moreover at Kelly's the smut of a coal was seen above the limestone outcrop.

Ascending Weir's Run from Ragar's, the *Upper Freeport coal* bed can be followed along the slopes as far as McGeary's house; but east of this it is lost, the outcrop line turning at McGeary's to run for a short distance nearly due north, past Aber's, and so on into the Black Lick Valley, where its course is somewhat obscure on both sides of the creek. It would appear, however, to be this same Upper Freeport coal that is exposed in a railroad cut just north of the bridge spanning Black Lick at the mouth of Two Lick. Further to the northeast, the bed is easily identifiable, but much increased in thickness, as is described in the succeeding chapter.

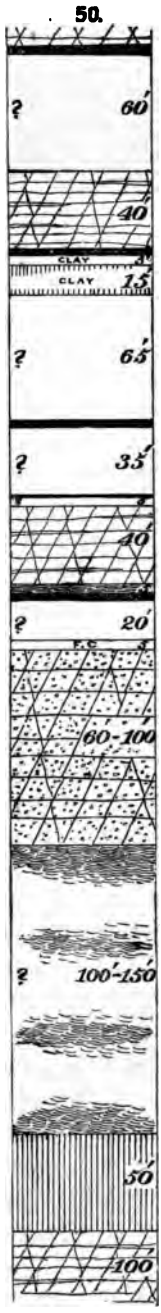
Black Lick Creek.

Black Lick Creek in the neighborhood of Bells Mills flows through a wide and irregular valley made up of the Lower Productive Coal Measures. These rocks are crossed in ascending the creek from the mouth of Two Lick, the base of the group appearing at the brick works, about one half mile above the village of Bells Mills. For nearly a mile above the brick works there is little or no change in the geology of the valley, the stream in this distance running not as before, *across* the rocks, but *along their strike*, and as the fall in the creek bed is slight, we find the rocks at Dr. Simpson's mill occupying relatively to the creek the same position, and generally speaking the same levels that they do at Meldren's brick works. It was in consequence of this fact having been overlooked that the much sought for stratum of fire clay underlying bed A was never found on the Simpson property.

The Conglomerate of XII rises above the creek a few hundred feet to the east of Dr. Simpson's mill, and thence to the centre of the gap only Conglomerate and sub-Conglomerate rocks occupy the bases of the slopes; but the top of the ridge is coal bearing, including even the base of the Mahoning Sandstone.

This Black Lick section forms an interesting contrast to the column of measures exposed in the Packsaddle gap, where the Pottsville Conglomerate makes the top of the mountain. The change is due to geological causes already explained with sufficient elaboration elsewhere in this Report.

Only the outlines of the section need here be reproduced:



Mahoning Sandstone, . .
Coal E, Upper Freeport, ... 4′ 0″–6′ 0″

Interval, ... ? . . . . . 60′ 0″?

Coal D′, Lower Freeport . . . . . not seen.

Freeport Sandstone, ... 40′ 0″

Coal bed D, ... 4′ 0″
Clay, ... 5′ 0″
Limestone and clay, ... 15′ 0″

Interval, ... ? . . . . . 65′ 0″

Coal bed B, ... 4′ 0″

Interval, ... ? . . . . . 35′ 0″
Coal bed A′, ... 1′ 0″
Interval, ... 5′ 0″

Sandstone, ... 40′ 0″

Slates, ... 5′ 0″
Coal bed A, ... 4′ 0″
Interval, ... 20′ 0″
Fireclay; B'k Lick F.C., ... 5′ 0″

Pottsville Conglomerate, (XII,) . . . . . 60′ 0″–100′ 0″

Shales and concealed rocks, ... ? . . . . . 100′–150′ 0″

Mountain Limestone, ... 50′ 0″

XI.

Sandstones, X, ... 100′ 0′

Creek level, in gap.

The centre of the Chestnut Ridge axis crosses Black Lick about two miles above Dr. Simpson's mill, the stream flowing in that distance a nearly due west course. The gap is an unbroken wilderness from Heshbon to Bells Mills, the clearings being confined to the top and flanks of the Ridge.

The area of *Formation X* exposed in this gap is small, and the rocks composing it chiefly concealed. *Formation XI* makes a much longer circuit, its outcrop line being plainly marked by the bold cliff of cherty limestone 50 feet high that skirts the creek for a considerable distance at the centre of the gap. From the base of this limestone (which is the Mountain Limestone, the base of XI) to the first coal bed of the Lower Productive group is vertically measured 310 feet, which is at once the combined thickness of XI and XII; of this interval XI consumes certainly as much as 200 feet, and probably 250, making the thickness of XII between 60 and 100 feet. So far as these measurements are concerned, they agree almost precisely with what was obtained at the Packsaddle.

A stratum of compact, coarse grained sandstone marks the outcrop of a portion of *Formation XII* at the centre of Black Lick gap. At this place, and only a few feet above the top of the sandstone, coal was known and opened many years ago, but was more recently explored by Dr. Simpson, who describes it as a bed five feet thick, parted by a thin band of clay. This is clearly the lowest coal of the Lower Productive Series, *bed A*. The second bed of the group seems to have been found on the Hildebrand property, one mile distant, and on the opposite slope of the gap, while at a point 200 feet (by barometer) above the outcrop of *bed A*, a seam of coal four feet thick has been extensively developed by Barr and others. This is believed to be the representative of *bed D*. *The Upper Freeport* seam then crowns the hill about one hundred feet still higher on the slope, the bed appearing only in isolated knobs, the principal one of which is on the S. Palmer farm, where the seam is mined showing thus:



This section differs somewhat from the exposures of the Upper Freeport coal on Tom's Run and also Wier's Run, but bears a strong resemblance to the condition of the bed in the Homer region further north.

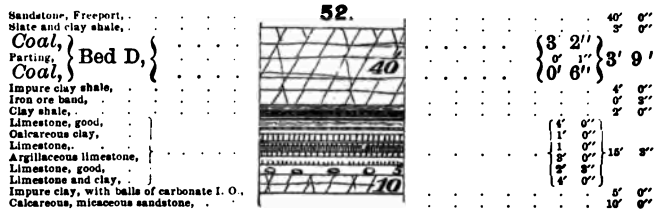
Only a few acres of this coal, lying almost horizontally, are contained on the Palmer property, these rocks disappearing as the western flank of the Ridge is descended, having been eroded from that part of the slope. But the northwest dip finally brings the Upper Freeport seam from the air down again into the hills near the base of the Ridge. Of its condition as it approaches water level in this region sufficient has been said above.

It is possible, in view of the sharp dip (6°–7°) affecting the measures at Bells Mills, and in view also of the abundance of heavy sandstone that goes beneath the creek between the mills and the R. R. crossing, that the Upper Freeport coal has not yet been discovered at water level on Black Lick, which would make the coal in the railroad cut just beyond the bridge occupy a position in the Lower Barrens. The identification is, however, extremely improbable.

The Lower Freeport coal has not been unearthed at Bells Mills; it would likely be found close to the Presbyterian Church near the Bells Mills bridge.

The Freeport Sandstone is a conspicuous feature of the section. In places it is quite massive, but is chiefly current bedded and fine grained. It is forty feet thick in all, and handsomely displayed in a bold cliff opposite the grist mill.

Beneath this sandstone is *bed D*, four feet thick. This part of the section, including the *Johnstown Cement bed*, is very complete, and may be reproduced from the notes:



In this section the unusual thickness of the limestone deposit beneath coal bed D is especially noteworthy. It is finely exposed in the left bank of the creek just above the bridge. The measures are here dipping sharply to the northwest, and the deposit quickly disappears beneath the stream bed. The same angle of incline speedily thrusts the coal into the air going east, but its outcrop line bends southwest towards Aber's fields, through which it passes above water level.

Portions of the deposit yield good fertilizing material, but much of the limestone is greatly intermixed with impurities, and is unfit even for agricultural purposes. The specimen selected for analysis was taken from the top band, and while not especially pure, nevertheless calcines readily and produces a tolerably good lime. The analysis in full is as follows (A. S. McCreath):

"Carbonate of lime,	78.768
Carbonate of magnesia,	2.421
Oxide of iron and alumina,	3.540
Sulphur,	.097
Phosphorus,	.018
Insoluble residue,	13.790"

The limestone is very firm, of a bluish color, and semi-crystalline.

The small stratum of carbonate iron ore resting almost immediately under the coal is persistent as far as the deposit is exposed. It is apparently quite rich in iron, but is devoid of economic interest in consequence of its small size.

In the interval between the limestone and the water's edge should occur *bed C*, of which, however, nothing is known here, the rocks composing the interval being entirely concealed. The coal reported in the creek bed just

below the dam is *bed B*, which would then belong about 25 feet above the heavy sandstone deposit that forms a vertical wall of rock along the north bank of the creek from Meldren's brick works to Dr. Simpson's mill.

It is this *bed B* that was once opened by Dr. Simpson on Black Lick, one mile above Bells Mills. It is reported as having a thickness here of four feet, without persistent partings of slate, but yielding a rather pyritous coal. The bed is overlaid at Dr. Simpson's mill by 20 feet of shales and slates, containing nodules of carbonate iron ore, which in one place unite into a continuous band, only however a few inches in thickness. This ore deposit has been thoroughly investigated by Dr. Simpson, and so far as yet uncovered the quantity of ore is insufficient to merit any further attention. Several specimens of the ore were analyzed by Dr. Otto Wuth, of Pittsburg, some of the pieces showing as high as 40 per cent. of metallic iron, and others again running down as low as 20 per cent. Such nodules and lumps of ore are of frequent occurrence in the Coal Measures, but being of an inconstant and unreliable nature they are of no value.

Beneath the coal is a mass of clay 12 feet thick, below which is another band of ore claimed to be 3 feet in thickness. This was not exposed at the time the region was examined, and the dimensions of the stratum are given on the authority of Dr. Simpson. Such an ore stratum, if it should really prove to be such and not merely a band of ferriferous limestone, is of rare occurrence in the coal rocks. It is at the horizon of the Hooversville ore of Somerset county, and corresponds most likely in geological position to the Ferriferous limestone of the Allegheny River region.

Below this ore band was discovered on Dr. Simpson's property a deposit of coarse fire clay, which however did not repay development, being too much intermixed with siliceous and feruginous matter. The thickness of the clay at this place is given as five feet.

Beneath this is the important sandrock deposit overlying *coal bed A*, and a good guide to the identification of the latter seam. This is the sandstone that was alluded to

above as forming the abrupt high cliff opposite Meldren's Fire Brick Works. It rises nearly vertically from the water line at Dr. Simpson's mill, showing there as a coarse grained, massive sandstone 40 feet thick; but at a distance of about $\frac{1}{8}$ mile down the creek, at Berry's house, the same rock is much current bedded and fine grained, its color having also changed from gray to green.

Almost directly beneath this sandstone, which might readily be mistaken for a part of the *Conglomerate of XII*, is *coal bed A*, the coal worked by Mr. Meldren at the brick works and again by Mr. Berry, but not elsewhere exposed in this immediate vicinity. The roof slates of the coal were partly uncovered just above the water's edge at Dr. Simpson's mill, but the coal bed has never been opened or explored there.*

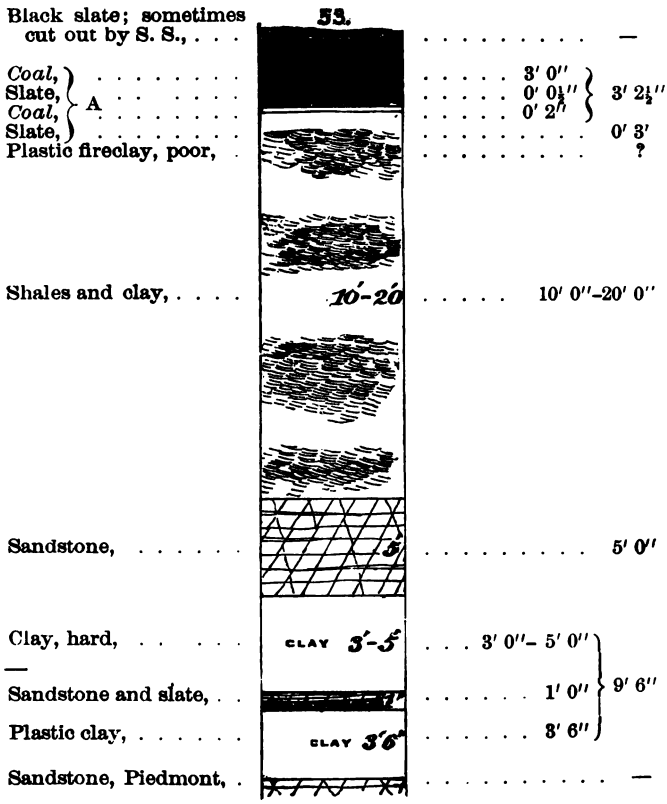
The coal is highly pyritous, and so far as exposed it seems never free from ruinous quantities of this impurity. It is used in the brick works for steam purposes and for baking the clay. An average specimen gave the following results on analysis (A. S. McCreath):

Water,	.560
Volatile matter,	27.880
Fixed carbon,	61.920
Sulphur,	3.610
Ash,	6.030
	100.000
Coke, per cent.,	71.560
Color of ash,	Lilac.

"The coal is bright, exceedingly tender, and carries a large amount of iron pyrites in thin partings."

Fig. 53 is intended to show the relationship between coal bed A and the fireclay deposit of this region:

*It has been supposed that the coal bed opened by Dr. Simpson, about 50 feet above water level at his mills, is the same seam as that now worked by Messrs. Meldren and Berry. That this, however, is an error will easily appear from the above description of the strata; but it is of especial importance that the matter should be set permanently at rest, because it was in consequence of this misidentification that the repeated efforts to find the Black Lick fire clay at Simpson's mills, were unavailing.



The *fire clay deposit* of this region has acquired some commercial celebrity, and justly so, because the clay when carefully selected and the two varieties properly mixed produces a brick of high refractory power. It exists in great abundance, is easily mined, and is favorably situated; moreover, it loses nothing in thickness or in character in ascending the stream, remaining in all respects even and regular. It has been traced as far up the creek as Berry's house, where it has been worked, but beyond this point aside from its outcrop it is not known, having hitherto been overlooked in the explorations on Dr. Simpson's property.

The plastic clay immediately underlying the coal is not worked, sufficient clay of this variety and of better quality

being obtainable just below the band of hard clay, an interval of about one foot separating the two deposits.

The upper band yields a smooth, hard clay of very even grain. The specimens for analysis were taken from Mr. Meldren's mine; they gave the following results, No. 1 representing the upper band, and No. 2 the plastic variety (A. S. McCreath):

	I.	II.
Silica,	64.830	68.490
Alumina,	23.950	18.460
Protoxide of iron,	.900	1.566
Titanic acid,	.880	2.150
Lime,	.110	.230
Magnesia,	.187	.551
Alkalies,	.296	2.755
Water, &c.,	9.390	6.310
	100.543	100.512

This deposit of fire clay resting immediately on top of *Formation XII* is one that is widely outspread in the Bituminous coal regions. It is this clay that is worked by Mr. Hawes at Mineral Point, in Cambria county, and it is likewise this deposit that supplies the brick works along the line of the Tyrone and Clearfield R. R. in Clearfield county. It is nearly always in good condition and of workable dimensions.

Chapter XIV.

The Lower Productive Coal Measures as exposed along Two Lick and Yellow Creek in the Blairsville Basin.

Crossing Black Lick Creek to proceed northeast along the base of Chestnut Ridge by the Homer road from Bells Mills, there is no change to record in the general geology of this region as compared to that described in the last chapter. The Lower Productive Coal Measures continue to occupy the summit and flank of the Ridge; and the same rocks are crossed by all the streams, large and small, descending into Two Lick, and also by the Two Lick itself, but only as far down the latter valley as the "Two Lick upper mills," beyond which to the west, past Homer, and beyond this to its junction with Black Lick, Two Lick flows over Lower Barren rocks. This latter fact is of considerable importance, inasmuch as the high Two Lick bluffs overlooking Homer are thereby condemned as non-coal-bearing. These bluffs, supporting the rich pasture lands of western Centre and Black Lick townships, have been searched again and again by the farmers for coal beds of workable dimensions, but always without success. They yield abundance of good limestone that would serve well to enrich the stiff clay soils that sometimes overspread the surface in this vicinity.

The outcrop of the *Upper Freeport* coal is crossed a few hundred yards north of Bells Mills, the road then rising quickly above it into the Mahoning Sandstone, which covers the surface and makes the country rock at the School House ½ mile north of the village. At Mr. J. Rugh's house the *Upper Freeport coal bed* is only a short distance beneath the surface, its outcrop being plainly defined by a

high bench which rises rapidly on the slopes east of the house.

The coal appears above water level in the shallow valley of a small nameless run that joins Two Lick at the Lutheran Church. The lower part of this ravine is occupied by the Mitchell and Col. Shephard properties (Zach farm), on both of which the bed has been opened. It passes beneath the run before reaching the railroad crossing, but looking eastward its outcrop runs along the sides of the ravine to extend far up the mountain flank.

The bed is here six feet. In this, however, is included a damaging slate parting that ranges within about one foot of the roof, and virtually reduces the seam to a bed four feet thick, inasmuch as it renders the upper bench of coal worthless for all practical purposes, the slate parting being too thick to be profitably taken down. Moreover, this system of mining is here rendered obligatory because of the great weakness of the roof slates of the coal.

As on the Conemaugh at Bolivar, so along the lower waters of Two Lick and Yellow Creek, this great parting of clay and slate is the most conspicuous and distinctive feature of the Upper Freeport coal bed. It is so persistent and continuous throughout the Homer region as to render the bed easily identifiable there. Not a single section of the seam as exposed in the numerous drifts along the lower waters of Two Lick and Yellow Creek but what shows this parting always in the same position and nearly always of about the same thickness.

The seam yields very little good fuel in its raw state. Above the parting the coal is mainly a sulphurous cannel slate and commercially worthless. A small zone running near the centre of the lower bench yields excellent coal, and it is interesting in this connection to recall the fact that the same zone is equally free from impurities at Lockport, on the Conemaugh, the two analyses being in fact nearly identical, even with respect to the amount of the hydro carbon gases contained in the coal, although the Chestnut Ridge anticlinal runs between the two points, and the two localities are in different basins. The analyses in general

of the Upper Freeport coal in the Third Basin show a much greater percentage of volatile matter than the analyses of the same bed in the Ligonier Valley, excepting in this one case.

The lower part of the bed in the Homer region is slightly pyritous, but this impurity occurring chiefly as bands and concretionary masses could be gotten rid of in the "washer," if it were desired to coke the coal. The lower bench is very free from earthy impurities, the analysis of its most slaty part showing only a trifle over 4 per cent. of the whole.

The following section made in the mine on the G. A. Maxwell farm, adjoining Col. Shephard's property on the north, does not show the full thickness of the bed at this place, but it reveals its main features:



Sandstone, Mahoning,	—	
Slate, thin, usually abs'nt	—	
Coal,	1′ 8″	5′ 11″
Slate and clay,	0′ 9″	
Coal,	3′ 6″	
?		

Freeport Limestone. Mr. D. Zach, of Homer, the former owner of the Shephard property, informs me that limestone was once exposed on the farm, at an interval of 10 feet below the Upper Freeport coal. The full thickness of the stratum was not ascertained, only the top of the deposit having been uncovered; but judging from its condition a few miles to the northeast, that is, on Tearing Run and along Yellow Creek, it is not less than six feet thick.

In the Maxwell mine, so far as this extends, the *Mahoning Sandstone* is usually the roof of the coal, without a particle of intervening slate or clay. Yet the upper bench of the coal in no way suffers from its immediate contact with the sandstone. Nor was any irregularity from this source noticed in the drifts above Homer, where, in spite of the massive sandstone roof usually prevailing, the upper bench of the bed is quite as even and regular as its congener below, which rests upon a smooth floor of clay and is roofed by the thick parting of slate that divides the seam.

Passing northeast of Maxwell's the coal makes a beautiful bench at the foot of a low hill. Its outcrop is crossed by the Homer road at the School House, where it is plainly exposed; but to the north of this, past Tearing Run and on past Homer, the township road is above the coal, the Mahoning Sandstone covering the surface and appearing in the R. R. cuttings, as for example at the Water Tank.

Advancing now to Tearing Run, the upper part of this ravine affords access to nearly all the coal beds and other strata of the Lower Productive group, and its northern slope will be the starting point of extensive drifts, if ever such be established here on these coals. All the seams of the lower group run uninterruptedly from this point to the Yellow Creek valley, offering thus an unbroken expanse of coal, above water level, of more than one mile in width, while lengthwise in a northwest and southeast direction the coal spreads in great sheets up and down the mountain flank.

A large part of this section of country is owned in fee simple by the Indiana Coal Company, which company holds also in addition extensive mining rights. But no works have as yet been established here, nor would the present condition of the coal trade justify any such movement.

The Upper Freeport coal bed is underneath the waters of Tearing Run, as high up the ravine as Coy's saw mill. But after its emergence above the water line it rises rapidly on the slopes towards the east and southeast, and has been explored on nearly every farm in the upper part of the valley.

It is now most extensively mined on the property that goes by the name of the "Bracken farm." It is there roofed by a high hill, in which the *Mahoning Sandstone* as a heavy, compact rock is the most conspicuous feature. Huge boulders of this sandstone are seen on the surface close to the township road, a few hundred yards west of the Bracken mine.

As here developed, the *Mahoning Sandstone* furnishes excellent building material, not only for heavy foundations, but equally well for purposes of decoration. This is fully

shown by the handsome court house building at Indiana, in the erection of which all the sandstone employed was taken from the Mahoning deposit above Homer. The rock is easily tooled, stands weathering well, and can be cheaply raised in the Tearing Run region, being present in prodigious quantities above water level.

The Upper Freeport coal shows the following section on the Bracken farm, the section being complete and showing the entire bed from top to base :



1. Black slate,		—
2. *Coal*, hard, slaty,	1′ 6″	
3. Slate and bony *coal*,	0′ 9″	
4. *Coal*, soft, friable, good	2′ 9″	6′ 8″
5. *Coal*, hard,	1′ 3	
6. Slate, } Not taken out	0′ 3″	
7. *Coal*, } in mining,	0′ 2″	
8. Slate,		—

Dip 3° to the N. W.

The specimen of coal selected for analysis from this mine was taken from the lower part of the main bench, No. 5 of the section. It shows a pyritous coal, rather free from slate. The analysis in full will be found on page 203, where it appears in conjunction with the analyses of the specimens taken from other parts of the bed in this region.

The bed can be traced by the eye along the slopes to the summit of the Ridge, where it is exposed on the Gamble farm close to the centre of the anticlinal. It has here only a shallow covering of protecting rocks, and this proximity to the surface, though in no way affecting the size of the bed, has yet considerably damaged the coal.

From Gamble's mine the outcrop line of the bed keeps close to the summit of the Ridge, going northeast, until it is thrown eastward into the Ligonier Basin and westward into the Blairsville Basin by the gap of Yellow Creek. It is this outcrop line running past Gamble's mine that leads through the Dearmy fields, past Brown's, Findlay's, Stevens', &c., as already described in Chap. VII.

The Freeport limestone has never been explored at all along Tearing Run, although the surface soil, naturally

lean, has been much overworked and stands in great need of fertilizing material. The deposit outcrops 20 feet below the base of the coal on the Bracken farm. An outcrop of apparently good fire clay was observed immediately above the limestone.

The Lower Freeport coal (bed D′) is a small and unimportant seam in this neighborhood, just as it is along Yellow Creek. Its outcrop is very distinct on the township road a short distance east of the Bracken mine, from which it is here separated vertically by an interval of 60 feet. From indications here and also on Yellow Creek, it would appear that the *Lower Freeport* bed is accompanied throughout this region by its usually attendant stratum of limestone. But this is not certain, the exposures being very imperfect at this horizon.

Below this there are no rock exposures along Tearing Run for an interval of 115 feet, which most likely brings us to *bed B*, this being the seam exposed a few feet above water level on the Bracken farm. *Coals C and D* are therefore concealed here, as is also the *Johnstown Cement bed*, nothing whatever being seen of these strata anywhere in the valley. But they were all found along Yellow Creek, and are simply hidden on Tearing Run, the rock exposures occurring there being less complete than on Yellow Creek.

Bed B on the Bracken farm shows four feet of very soft and inferior coal. Only the outcrop has been exposed at this place, but ascending the run we find this same coal opened and mined on Mrs. McAdoo's property, just above the forks of Tearing. From water level at the Bracken farm it has risen to a point 50 feet above that line at Mrs. McAdoo's. This bed is considered identical with the so-called "four foot" seam at Findlay's and at Lewis', on the opposite flank of the anticlinal, but barely two miles distant from the exposures above described.

Along Tearing Run *bed B* is overlaid by 20 feet of black slates and fissile shale, while at only a few feet beneath the coal sandstone shows in the bed of run, thus concealing *bed A* and keeping it below water level in this valley across the Chestnut Ridge anticlinal.

The specimen of coal from *bed B* analyzed at Harrisburg only served to confirm the unfavorable impressions formed of the bed in the mine. Should the bed continue in the same condition, its coal would have little value, unless the particles of iron pyrites so abundantly scattered through it could be removed by washing.

The analysis in full is as follows (A. S. McCreath):

"Water,	.920
Volatile matter,	24.356
Fixed carbon,	62.218
Sulphur,	4.916
Ash,	7.590
	100.000
Coke, per cent.,	74.724
Color of ash,	Brick red.

The coal is exceedingly tender, and has a dull lustre, being very much coated with iron oxide. It carries numerous thin partings of mineral charcoal, and a large amount of iron pyrites."

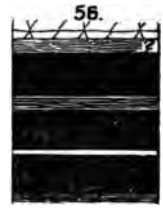
The developments along so much of the valley of Yellow Creek as falls within the limits of the present discussion are almost wholly confined to the *Upper Freeport coal bed*, of which there are frequent exposures. Some of the mines are worked quite extensively, this being the nearest point to the county seat of any workable coal bed above water level. And while large quantities of this coal are yearly consumed in the country round about, it confessedly does not rank as high as the coal from the Pittsburg bed, and for domestic use cannot compete successfully with the latter in the Indiana market, although the Pittsburg coal has to be brought at a considerable cost of transportation from either Blairsville or West Lebanon, near the Armstrong county line. One reason, and the principal reason for this preference of the Pittsburg bed, consists in the extreme friability of the Upper Freeport coal, which causes it not only to crumble considerably in mining, but to suffer still more from transportation, whereas the Pittsburg coal has a tendency to break into tough blocks that can be handled again and again. In the chemical compo-

sition of the coals, especially in the case of that coming from the Pittsburg bed at Blairsville, there is little or no difference.

The conditions for cheap and easy mining are very favorable along the Yellow Creek valley. Gangways could be driven along the strike of the rocks southwest to Tearing Run, or northeast to Two Lick; and such gangways would command enormous fields of coal. The projected Homer and Cherry Tree R. R. would furnish the region with an outlet to market; but this valley must doubtless lie idle yet a long time before operations on an extensive scale could be profitably carried on.

Ascending Yellow Creek from its mouth, the *Mahoning Sandstone*, in the same compact and massive condition that characterizes it along Tearing Run, is the county rock for nearly a mile. It is the upper part of this deposit that shows in the left bank of the stream at the Homer bridge. As the rock slowly rises above the water line it grows more and more conspicuous on the slopes, over which fragments and boulders of coarse and fine grained sandstone are strewn in great abundance.

The Upper Freeport coal bed, as exposed in this valley by Messrs. McDonald, Marcle, Shephard, Griffith, and Porterfield, is a double bed of uniform thickness, yielding in all about six feet of coal, of which the lower bench makes up nearly two thirds. The section is the same in all the mines, and about identical with that given for the same bed on Tearing Run. The following measurement made in Mr. D. Griffith's mine expresses fairly the average size of the seam on the lower waters of Yellow Creek:



1. S. S., Mahoning,		. . . . .	—
2. Slate, in lenticular masses,		. . . . .	—
3. *Coal*, Upper bench,		. . . .	1′ 6″–2′ 3″
4. Slate and *bony coal*,		. . . .	0′ 6″–0′ 9″
5. *Coal*,	Lower bench,	. . .	1′ 3″–2′ 0″
6. Slate,		. . . .	thin.
7. *Coal*,		. . . . .	2′ 0″
8. Slate,		. . . . .	—

7′ 0″

Just as on the Bracken farm, the upper bench of the bed,

No. 3 in the above section, consists of hard, slaty coal. Its condition is better expressed by the analysis given below, being No. 1 of the table. The upper part of the lower bench, No. 5 of the section, is here equally as free from impurities as on Tearing Run. As before stated, the specimen representing this zone of good coal was taken from the Bracken farm; its condition is shown by analysis No. 2. Analysis No. 3 shows the character of the lower part of the lower or main bench, No. 7, of the section. The analyses were made by Mr. A. S. McCreath, Chemist of the Survey:

	No. I. Upper bench.	No. II. Upper part of lower bench.	No. III. Lower part of lower bench.
"Water,	.590	.800	.700
Volatile matter,	28.710	25.770	29.680
Fixed carbon,	52.488	70.224	63.766
Sulphur,	5.462	.621	1.719
Ash,	12.750	2.585	4.135
	100.000	100.000	100.000
Coke, per cent.,	70.700	73.430	69.620
Color of ash,	Reddish gray.	Red.	Cream.

I. The coal is very tender, with resinous lustre generally. It contains numerous thin partings of mineral charcoal and iron pyrites.

II. The coal is bright and tender; it is somewhat coated with iron oxide, and contains numerous partings of mineral charcoal.

III. The coal is bright, shining, tender, and seamed with mineral charcoal and iron pyrites.

One interesting feature of these analyses is the variable amount of hydro carbons contained in the specimens. And, curiously enough, we find the largest amount of these gases in that part of the bed where we would naturally look for the least, namely, in the specimen nearest the floor. Moreover, the upper bench contains 3 per cent. more volatile matter than the central zone, a fact which can only be explained by the difference existing originally in the vegetation fromwhich the coal has been formed. Otherwise the analyses need no comment.

The Freeport limestone, here 19 feet below the Upper Freeport coal, is itself almost immediately overlaid by a small stratum of coal one foot thick. This small seam was frequently observed elsewhere in the county, and apparently it runs over certain areas with considerable persistency and regularity. The limestone so far as exposed on the Griffith property exists as two layers, separated by an interval of 7 feet. In this interval occur the iron ore bands described below. The limestone is of a bluish cast, slightly fossiliferous, and slakes easily. The specimen forwarded to Harrisburg for analysis gave the following results (A. S. McCreath):

"Carbonate of lime,	72.264
Carbonate of magnesia,	6.493
Oxide of iron and alumina,	4.190
Sulphur,	.068
Phosphorus,	.029
Insoluble residue,	14.980"

Carbonate iron ore is very frequently associated with the Freeport limestone; but it is rarely of sufficient thickness to merit attention. Occasionally, however, it swells into a workable deposit, as for example at Brady's Bend on the Allegheny River, where a considerable amount of ore has been raised from this stratum. And it is likewise of importance on the lower waters of Yellow Creek, although in that region it has as yet been very little explored; but what little is there known about it is of a favorable character, the ore being quite free from phosphorus and sulphur, and containing for an iron stone a liberal percentage of metallic iron. Only the extreme outcrop of the deposit has been exposed, and then only on the farm of Mr. D. Griffith. It is divided into two layers, which together aggregate two feet of ore. Should this thickness prove continuous the deposit will form a valuable adjunct to the other mineral attractions of the region. For the rocks associated with the ore bands see Fig. 57, given below.

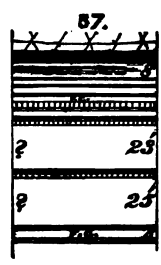
A fair average specimen of the ore gave the following results on analysis in the Laboratory at Harrisburg (A. S. McCreath):

"Carbonate of lime,	16.607
Carbonate of magnesia,	7.113
Carbonate of iron,	59.278
Alumina,	3.273
Sulphur,	.066
Phosphorus,	.051
Insoluble residue,	11.600
Metallic iron,	28.600"

The Lower Freeport coal, bed D', out crops onthe same hillside, 55 feet by barometer below Mr. Griffith's mine on bed E. Its thickness is given as 1½ feet. On the Shephard property, adjoining Mr. Griffith on the east, are indications of the *Lower Freeport limestone.*

Bed D and the Johnstown Cement limestone have been exposed on the Shephard farm, where they have a combined thickness of about 3 feet. *The Freeport Sandstone* is in place above the coal.

The following section constructed on the Griffith and Shephard properties is intended to show the sequence of the strata so far as these are exposed, from the base of the Mahoning Sandstone to the base of the Johnstown Cement bed :



1. Mahoning sandstone,		
2. *Coal*, U. F. bed E,		6′ 0″
3. Clay, with band of S. S. and slate,		8′ 0″
4. Iron ore,		0′ 2″
5. Clay,		3′ 0″
6. *Coal*,		0′ 1½″
7. Clay,		4′ 0″
8. *Coal*,		1′ 0″
9. Fireclay,		3′ 0″
10. Limestone,		3′ 6″
11. Iron ore,		1′ 0″
12. Fireclay,	Freeport ore,	3′ 6″
13. Iron ore,		1′ 0″
14. Fireclay,		1′ 6″
15. Limestone,		2′ 0″+
16. Interval,		23′ 0″
17. *Coal*, L. F., bed D',		1′ 6″
18. Limestone,		?
19. Interval,		25′ 0″
20. *Coal*, bed D,		1′ 8″
21. Fireclay,		8′ 0″
22. Limestone, Johnstown cement,		1′ 6″
		96′ 5 1-2″

Excepting at the centre of the gap of Chestnut Ridge little investigation has been made along Yellow Creek of the coals at the base of the Lower Productive group and these openings and exposures have already been described and the coals identified in Chap. VII. The measures continue to rise slowly above the creek level in ascending the stream from the Shephard farm, but their outcrops are mainly concealed. One of the lower coal beds (and proba-

bly B) is worked on the Snyder property, and again on the Platzer farm close to the Armagh road. It is four feet thick and yields rather pyritous coal.

Ascending the creek above this into the gap, the high slopes containing all the Lower Productive Coals are a wilderness until we come again into the lowlands beyond Fetterman's fording at the opposite end of the gorge. In this interval XII and a part of XI rise above and fall again below the drainage line; and before we have reached the forks of Yellow Creek not only the Lower Productive Coals, but the Mahoning Sandrock on top of these, have come down from the mountain top and disappeared beneath the stream bed.

Two Lick.

In ascending the deep valley of Two Lick, the *Upper Freeport coal bed* first appears above water level at the dam above the "Upper Two Lick mills." Thence to the "Lower mills" more than a mile down the stream, the coal bed is beneath the creek, the *Mahoning Sandstone* making all the bluffs and cliffs, and desolating the valley with great boulders of rock.

At the "Upper Mill," ⅛ of a mile below the dam, Dr. St. Clair sank a shaft through massive heavy sandstone to the *Upper Freeport coal*, touching this at a depth of 60 feet below the surface. The dip of the rocks in the shaft is stated by Dr. St. Clair to be 4° to the northwest. This dip must however rapidly flatten in descending the creek, for about midway between the mills, it meets the reverse (S. E.) dip, caused by the Indiana anticlinal which runs through Cherry Hill township only a short distance west of the "Lower Mills." Hence at these "Lower Mills," where the Mahoning Sandstone is finely exposed in a series of bluffs, the Upper Freeport Coal is not much, if it is any deeper below the Creek level, than it is at the point where Dr. St. Clair sank his shaft.

Dr. St. Clair's mine has never been operated, but the work of sinking the shaft was well done and will stand for years.

It is the most favorably situated mine in the County for the supply of the Indiana market with fuel, and steps will shortly be taken to place the works in running order.

The bed has here the same thickness as along Yellow Creek, showing a section almost identical with those given a few pages back. In the same condition, also, it runs up Two Lick, rising slowly higher and higher on the slopes, until at the eastern edge of the Agey farm it is one hundred feet above water level, while at Porterfield's mill, still further up the creek, the bench of the bed is just below the hill top. This makes a sufficient vertical interval to allow the lower seams of the series to rise above water level, and at Porterfield's mill, near the point where the Ebensburg pike crosses Two Lick, nearly every bed (certainly every important bed) of the Lower Productive Measures was recognized in the steep slopes of the valley.

In the following description it is intended merely to point out at what localities the principal strata of this series outcrop, and may be seen in the interval between the "Two Lick Upper Mills" and Diamondville, near the centre of the Two Lick gap of Chestnut Ridge. The column of rocks is considered in descending order.

The Mahoning Sandstone is so heavy and so massively bedded in this region that no difficulty whatever is experienced in tracing it past the "Upper Mills," and on thence east and northeast to the school house on the pike, one mile west from the creek at Porterfield's. It would here furnish good building stone just as on Yellow Creek and at Greenville; further to the northeast, in the neighborhood of Taylorsville, it seems to lose its massiveness, but only temporarily, as it again assumes the same form still further north at Smithport.

Excepting at St. Clair's and on the Agey farm *the Upper Freeport coal bed* is little known in the Two Lick hills. It owes this obscurity along the upper waters of Two Lick chiefly to the presence at the base of the hills, (and hence more favorably situated for mining) of a bed of similar thickness, namely *bed B*. But although never systematically explored, the outcrop of bed E is very distinct along

the western bluffs of the Creek, having been seen on the Bennett and Isenberg properties, and again on the Lydick farm still further north. At all these places it is near the hill top. Its thickness here is not definitely known, but it probably maintains the dimensions it shows at Agey's and St. Clair's. These are as follows:



1. *Coal*,	2	3″	
2. Slate,	0	10′	7 3′
3. *Coal*,	4′	2	

In character, structure and general appearance of the coal there is no variation from the condition of the same bed in the Yellow creek region.

The Freeport limestone is very little known until we reach the Dixon's Run Valley in the latitude of Taylorsville. It has, however, been opened on the Agey property, at the usual distance below its coal; and the same deposit seems further to have been discovered on the Lydick property, but was never fully explored there.

The Lower Freeport coal seam, though small, is yet mined in the vicinity of Porterfield's mill; the same bed becomes the principal and main source of the coal supply in the valley of Dixon's run, as will be shown presently. On the Isenberg and Bennett farms, where the bed has been opened up, it shows on the average about three feet of coal including a small parting near the floor. The coal is pyritous and in its raw state makes poor fuel. The bed rests between two strata of clay on the Bennett farm thus:



1. Clay,		—
2. *Coal*,	2′ 10″ –	3′ 0′
3. Clay,		3′ 0′
4. Limestone,		6′ 0″?

The section also shows the *Lower Freeport limestone* which is here of a ferriferous nature. Its thickness is given on the authority of Mr. Isenberg, the full outcrop of the lime stone not being now exposed.

Fifty feet below this, on the Isenberg hill, is another limestone band, above which, at the extreme outcrop, is a small coal smut. These together clearly represent *coal bed D* and its underlying *Johnstown cement seam.* The same limestone stratum was again reported on the Lydick farm, where it was once partially opened up and showed four feet thick. Beyond this it has never been explored, either at Isenberg's or Lydicks.

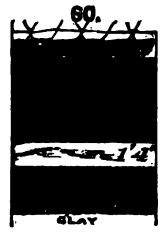
It is also coal bed D that occurs near water level on the Agey farm, 100 feet below the outcrop of the Upper Freeport seam. Its presence at this place has long been know, and many years ago it was opened at the outcrop and found to be 3½ feet thick.

From the *Johnstown Cement bed* we descend nearly 150 feet in the measures, and chiefly over concealed rocks, before reaching *bed B.* This is an expansion of 50 per cent. in the interval usually separating these strata. A small bed of coal, measuring about fourteen inches in thickness and occurring at about the centre of the interval, was observed on the Lydick farm. This small coal doubtless represents *bed C* of the series.

Bed B, usually the third coal in ascending order above the *Pottsville Conglomerate*, but nearly always the second seam if we consider only their value as workable deposits, averages 6 feet thick in the vicinity of Porterfield's mill, in the vicinity of which it has been exposed on the McClain property. It shows a section closely agreeing with those obtained from the same coal bed in the Conemaugh region and along Yellow Creek. The remarkable evennesss and regularity with which this bed runs over a large part of Indiana county has been sufficiently commented upon elsewhere in these pages.

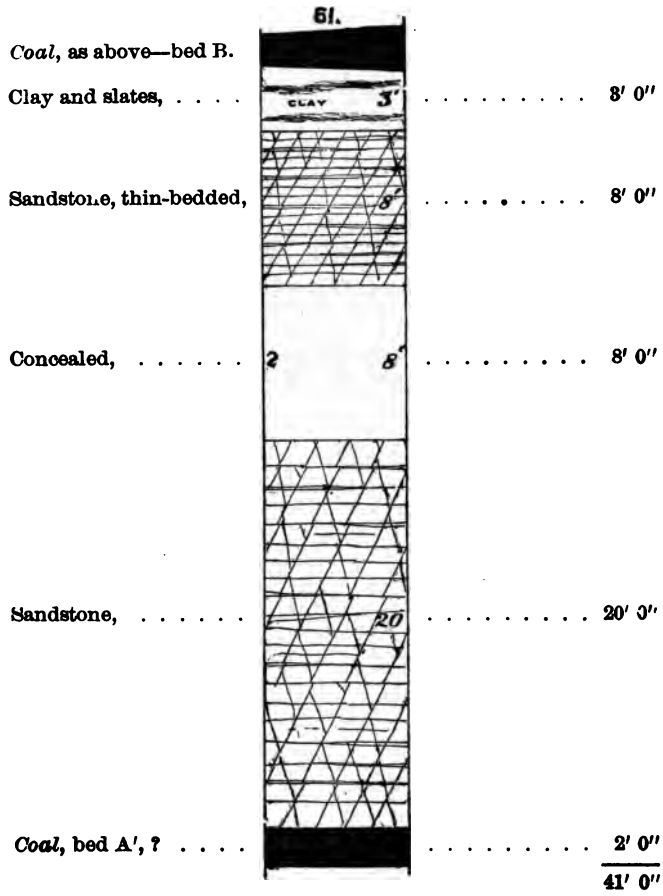
The bed in this locality is of an extremely inferior character, being not only slaty, but in places overloaded with iron pyrites. And, like the Upper Freeport bed, it too has a dam-

aging slate and clay parting, which for all practical purposes reduces the bed to a seam 4 feet thick. But it can be cheaply mined for domestic use, which is at present its only market. Combining the McLean and Lydick sections of the bed we obtain the following:



1. Sandstone,		
2. Slate,	0′ 3″	
3. *Coal*, bony,		
	3′ 4″– 4′ 0″	7′ 11″
4. *Coal*, pyritous,	1′ 1″– 1′ 4′	
5. Clay and slate,		
	0′ 8′–2′ 4″	
6. *Coal*,		—
7. Clay,		—

Beneath this at Lydick's the section is continued downwards to a small seam of coal that has been opened up by Mr. D. Fyhock, and was also exposed on the farm of Mr. Lydick. This possibly may represent bed A, but it is more likely bed A′, which runs through the measures between A and B coals. The section is shown in Fig. 61:



Higher up the stream, and on both sides of the creek as well as in the deep ravine of Penn Run, these lower coals have been repeatedly exposed. The mines deserve no special description, and the beds worked will identify themselves if the facts above recorded be correctly applied.

At the centre of the Chestnut Ridge anticlinal, below Diamondville, the *Conglomerate of XII* rises above the creek, thus placing the entire group of Lower Productive rocks in the hills at that place, as already described in Chap. VII.

Dixon's Run.

The little valley of Dixons Run leads from the Two Lick Creek to the top of the divide between Two Lick and the Mahoning. Ascending the little valley of the run from Two Lick we start in rocks at or near the base of the Lower Productive system, and slowly rise in these measures until finally the slope of the stream bed carries it above them into the Lower Barren group.

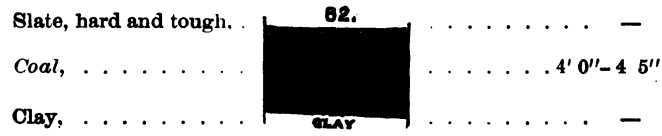
The coal mined at present in this valley comes entirely from the *Lower Freeport bed.* The seam varies somewhat in thickness at different points, but invariably yields a good clean coal. The existence of other coal beds both above and below that now worked is well known, but there is no inducement to further investigate them.

What little limestone has been used by the farmers in fertilizing the soil has been taken from the Freeport deposit, here an important and valuable stratum yielding excellent limestone, easily raised, and giving off its carbonic acid quickly in the kiln. It should be far more extensively worked by the farmers, who seem aware of its presence, but having never used it to any extent are slow to make a movement in that direction. Once such a movement were made, and the beneficial results flowing from it fully understood, the farms of Dixons Run valley would soon present a very different appearance from what they now do.

The lower part of the valley, that is, from the School House at Woodison's to the mouth of the run, has been very little explored for its mineral contents. The developments begin at Woodison's and extend beyond Dixonville, where the Lower Freeport coal is close to water level.

Bed D was once uncovered near the grist mill; it showed 18 inches of coal. Underneath it was the *Johnstown Cement bed*, four feet thick, and according to Mr. Woodison, who exposed these strata, made up of good stone.

About 50 feet above this exposure the *Lower Freeport coal* outcrops, which in Mr. Woodison's mine shows the following section:



It is without any persistent partings of slate; the coal is somewhat tender, has a rich lustre, and seems very free from iron pyrites.

The same bed has twice been opened at Dixonville, but shows here a reduction in thickness of 25 per cent. from the above. No change in the character and appearance of the coal was noticeable. The outcrop of the bed extends a short distance above Dixonville before being concealed by the run.

The Freeport limestone makes a distinct outcrop in all the fields at a point 40 feet above coal D′. It has been partially exposed by Mr. Woodison, and again by Mr. Shadrick, and shows also plainly on the State road a few hundred yards west of the run at Dixonville.

All that is known of the *Upper Freeport coal*, in this section of country, is the outcrop that occurs a few feet above the limestone last described. It is unmistakable at Dixonville, as is also one of the small coals of the Lower Barrens: the *Philson seam* of Berlin one hundred feet above E.

The outcrop of the *Upper Freeport coal*, whatever may be the condition and thickness of the seam, extends nearly to the headsprings of the run, not far from Decker's Point.

On the Shadrick property, close to Dixonville, a test hole was sunk a few hundred feet, some years ago, in the hope of finding oil in paying quantities. The enterprise was a failure, and is mentioned in this connection only to allude to the supposed existence of a bed of coal, 16 feet thick, alleged by those who superintended the boring of the well to have been pierced at a depth of about 40 feet below the surface. There is clearly some error in this statement, the error probably arising from black slate having been mistaken for coal, these two being often difficult to distinguish in the fine pulpy black mud that is brought to the surface when the bit of the drilling instrument is passing through

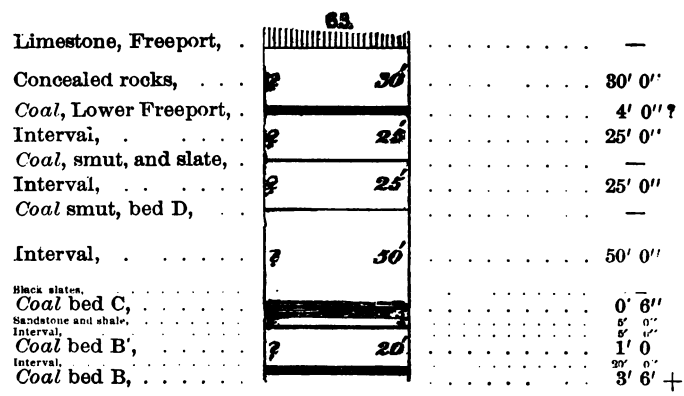
such strata. The existence of the coal at Shadricks has recently received confirmation in the minds of many, by the discovery of the large deposit of cannel slate near Decker's Point. This should not lead to any attempt to touch the supposed coal in the well, by shaft or otherwise. Of the error in the oil drillers' statement, any one may convince himself by observing the measures along the run between Shadrick's and Two Lick, in which interval all the Lower Productive rocks come to daylight, and there is no evidence of any such coal bed in them at this place.

From the valley of Dixon's Run, the rocks rise southeast towards Chestnut Ridge anticlinal, passing close to Taylorsville.

Buck Run.

The Lower Productive coal group is thus brought again to daylight in the ravine drained by Buck Run, which heads near the village of Taylorsville in Lower Barren rocks, and deepens towards Two Lick, the trend of the valley being roughly parallel to Dixon's Run and only about one mile to the east of the latter.

On the farm of Mr. W. Thomas, one mile southwest of Taylorsville, appears a series of coal beds all of which belong to the Lower Productive system. The section beginning at the summit of the hill and running down as low in the group as bed B, is very incomplete in the interval rocks, but it will nevertheless serve to show the extent of the intervals.



The lowest bed of the above section is opened and mined close to water level on the Gought farm. It yields a coal both sulphurous and slaty. Apparently the same bed is mined by Mr. J. Mock, ¼ of a mile to the southeast, at which place the coal dips to the S. E., while at Gought's the incline is equally marked, but to the northwest. This gives the exact position of the Chestnut Ridge anticlinal.

Probably the same coal (B) was once opened near Mr. D. Mock's house further down the run; but this was not definitely established.

The Lower Freeport coal as opened and mined by Mr. J. Helman on the high land separating Buck run from Dixon's run, is in the same high state of excellence that it appears at Woodison's in the Dixon's Run valley. And it further shows of the same thickness, overlaid by the same tough black slates, and resting upon a similar bed of impure fire clay. It makes a distinct crop on the Thomas farm, but has never been explored there.

Thirty-five feet above Mr. Helman's mine the *Freeport limestone* outcrops in the road, while the bench of the *Upper Freeport coal* is conspicuous in all the fields high enough to include it. The limestone is of a dark blue color; is streaked with thin seams of calcite, and contains numerous impressions of minute fossil shells. It has also been exposed at the hill top on Mr. Thomas' land.

Crooked Creek.

Crooked Creek in the Blairsville trough is of little interest in an economic sense until it crosses the Indiana anticlinal at Kintersburg, where it exposes nearly the whole group of Lower Productive coal beds. These exposures, however, are so intimately associated with those falling within the limits of the next trough to the west, that the two cannot well be separated without producing confusion in the mind of the reader. Their description is therefore reserved for a subsequent chapter in which will be discussed all the developments occurring in the Kintersburg region.

From its headsprings in White Township to the mouth of Rayne's run in Rayne Township, Crooked Creek flows,

through a broad smooth valley, flanked with easy slopes, in which only the Barren measures are above the drainage line.

Chapter XV.

The Lower Productive Coal Measures as developed along the Little Mahoning Creek in the Blairsville Basin.

The region discussed in this chapter embraces the area bounded by "Penn's Purchase Line" on the south, the Clearfield county line on the north, the Chestnut Ridge anticlinal on the east, and the Indiana anticlinal on the west. It includes nearly the whole of Grant township, a small corner of Montgomery, a part of Canoe, and a part of Banks.

Grant township is drained by the south branch of Little Mahoning Creek, the head springs of which are in the hills skirting the southern border of the township, and likewise dividing the Two Lick and Mahoning waters. Chestnut Ridge anticlinal runs diagonally through the southeastern corner of the township, and pours the combined waters of its western flank north of "Penn's Purchase Line" into the Little Mahoning, flowing northeast lengthwise through the township.

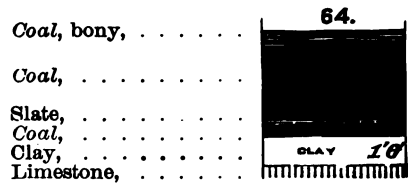
Canoe and Banks townships, (so far as the territory embraced within the limits of the latter township is situated west of Chestnut Ridge,) are drained in great part by the Little Mahoning, ramifying again and again, and sending its little branches in all directions.

In discussing the exposures of the Lower Productive Coal Measures in this part of the Blairsville trough, it will be more convenient to consider first the mines and developments occurring along the western flank of Chestnut Ridge, following this as far north as the county line; then to cross the basin at right angles and to take up the same rocks, again lifted to daylight along the western edge of the

trough by the Indiana anticlinal, and finally to follow along this axis southwestward to Deckers Point, the starting place of the South Branch of Little Mahoning.

After crossing the "Purchase Line," the summit of Chestnut Ridge becomes gradually freed from Barren Measure rocks by the steady rise of the anticlinal northeastward. At the point where the axis is crossed by a township road, near Mr. Rowley's house, the Lower Productive Measures are the surface rocks.

On Mr. Rowley's farm a seam of coal identified as *bed D* is opened and mined. This seam is the prevailing one throughout all this region, and can be traced for miles along the ridge by its unvarying section. It measures as follows in Mr. Rowley's mine, close to which runs the centre of the Chestnut Ridge anticlinal:



The limestone said to underlie the coal was not exposed, but it occurs repeatedly to the northeast in connection with this coal seam, and its existence at Rowleys is in every way probable.

Above the mine rises a shallow hill on which only a single coal bench shows at an interval of 65 feet by barometer above the mine. It is not known positively that this bench is coal bearing, but it most likely contains the *Lower Freeport seam.*

Bed D has again been opened on the adjoining farm of Mr. J. Stewart, who reports it 4½ feet thick.

Following along the crest of the Ridge for nearly two miles from the openings last described, we find coal D again exposed on the Wm. G. Walker farm, where by barometrical measurements the bed is at an elevation of 1680 feet above mean tide, Atlantic Ocean. The measures dip gently to the southeast in the Walker mine. The measurement

of the bed as here exposed is so similar to that obtained in the Rowley mine, that it need not be repeated. The Walker mine has been in operation for a number of years back, and the narrow entries and gangways have been driven a considerable distance under the hill, the coal remaining even and regular throughout.

A thin band of bright coal running near the centre of the upper bench is very free from impurities, being much sought after for use in the blacksmiths forge. Both above and below this central zone, the coal is more slaty, but not to a very damaging extent, excepting immediately beneath the roof slate, where the seam is bony and worthless. This small band of bony coal is an unfailing accompaniment of bed D in this region.

An average sample of the so called "blacksmith's coal," as well as an average sample of the run of the bed, were forwarded to Mr. McCreath, who analysed them with the following results, analysis No. 1 representing the small zone of "blacksmith's coal," and No. 2 being the analysis of the specimen from the lower part of the seam:

	No. I.	II.
"Water,	1.240	1.270
Volatile matter,	29.630	28.930
Fixed carbon,	65.172	60.175
Sulphur,	.503	.950
Ash,	3.455	8.675
	100.000	100.000
Coke, per cent.,	69.130	69.800
Color of ash,	Brown.	Reddish gray.

No. I. The coal is bright, shining, rather compact, with thin seams of mineral charcoal and iron pyrites.

No. II. The coal is bright, shining, rather compact, with thin seams of slaty coal and iron pyrites.

Both these analyses are very favorable, showing a coal quite free from sulphur.

Still further northeast, in the Gorman settlement, the bed has again been explored with results corresponding closely to those just described. At this place the developments

were carried downwards into the strata for several feet below bed D, and a thick deposit of limestone, representing the *Johnstown Cement bed*, has thus been exposed. The section is highly interesting and important, establishing as it does, the continuation of this deposit northeastward to within a few miles of the Jefferson county line. In detail the section is as follows:



1. Surface,		—	
2. S. S. Freeport, in part		3' 0"	
3. Black slate,		5' 0"	
4. *Coal*, bed D,		5' 2"	
5. Clay,		4' 0"	
6. Cement limestone,	2' 6"		
7. Clay,	0' 1"–0' 5"		
8. Limestone,	1' 0"		
9. Clay,	0' 0½"–0' 5"	10' 1"	
10. Limestone,	2' 6"		
11. Clay,	0' 1"–0' 3"		
12. Limestone,	3' 0"		
13. Fireclay slate,		2' 0"	
14. *Coal*,		3' 0"	
		32' 3"	

The coal bed at the base of above section is a novel feature at this horizon of the measures, which however are too little developed in this region to determine at present whether the seam is of a sporadic nature or whether it runs with any great degree of persistency down the valley of Little Mahoning Creek. It may possibly be *Coal C*, resting immediately underneath the *Johnstown Cement;* but this is unlikely. It was also observed on the adjoining property of Mr. D. G. Gorman of the same thickness as shown above in the section. Provisionally it may be called the *Gorman Coal.*

The limestone deposit is divided into three bands, one of which (No. 6 of the section) is of a cement character, carrying both iron and alumina in considerable quantities. This fact was sufficiently revealed by the refusal of the rock to calcine and slake down into lime. It is of a light gray color, compact and very hard. The specimen selected for analysis showed the following constituents (A. S. McCreath):

"Carbonate of lime,	36.214
Carbonate of magnesia,	16.883
Carbonate of iron,	8.078
Alumina,	4.360
Sulphur,	.056
Phosphorus,	.056
Insoluble residue,	32.790

The other layers, Nos. 8 and 10, yield a limestone of much better quality, although still far from pure. When calcined it produces a strong lime that has been used for fertilizing purposes by Mr. Gorman with very satisfactory results. A specimen of the stone gave the following results to Mr. McCreath:

Carbonate of lime,	58.750
Carbonate of magnesia,	16.005
Oxide of iron and alumina,	7.380
Sulphur,	.041
Phosphorus,	.085
Insoluble residue,	15.060

The Chestnut Ridge anticlinal passes through Mr. Gorman's fields, between his mine and that on the adjoining farm of his brother.

About 1½ miles northeast of this point *bed D* is again mined by Mr. Uber, and again by Mr. Weitzel, close to the village of Smithport. In both these mines the coal shows a section almost identical with those above described.

One third of a mile southwest of Mr. Uber's mine, from which considerable coal is extracted, a subjacent seam is exposed near the level of Straight Branch Run, by barometer 215 feet below the Uber coal. This lower seam, which was once mined on Straight Branch Run, measures 4 feet thick, yielding, it is said, a good quality of coal. It is

probably at the base of the Lower Productive group, being no doubt *bed A* of that series.

Near Mr. Uber's house the *Johnstown Cement seam* outcrops in the township road a few feet below its coal. It is moreover *bed D* that appears on the flat at Smithport, where it is scantily provided with rock covering. At the village the measures are almost horizontal, the anticlinal of Chestnut Ridge running nearly under Smithport.

At Cessna's saw mill, one and a half miles northwest of Smithport, Straight Branch Run flows over heavy sandstone, the same rock being likewise abundant on the slopes above the stream. In the hills to the west are several well marked benches, rising at intervals suggestive of the lower coal seams of the Lower Productive group. These benches are wholly unexplored at this place.

But at the saw mill close to the run occurs an extensive deposit of bog ore and ferruginous clay, the latter being sufficiently free from sand to be adaptable for rough painting when dried and pulverized. The bed exists on both sides of the stream at Cessna's mill, and where dug into on the eastern bank is four feet thick, showing two distinct strata of clay that vary in color according to the extent of the oxidation that has taken place. The upper layer is of a dark red color, while that below is yellow, both yielding shades of paint corresponding to these hues. The bands are of equal smoothness, producing when ground a light dusty powder that has been quite extensively used in the country round about for outside painting, and is recommended for its durability. The clay exists in prodigious quantities, running up and down the creek on both sides for a considerable distance. Small works for drying and grinding the clay were erected by Mr. Cessna in the hope of bringing it into more general use in the surrounding country. Geologically the deposit is either in the *Conglomerate of XII* or at the base of that formation. A similar clay, though not so free from sand as that obtained at Cessna's mill, was observed near Enterprise, on Little Mahoning Creek, one mile above the village of Richmond. This latter deposit is in *Formation XI.*

Northeast of Straight Branch Run the country is a wilderness along the flank of Chestnut Ridge to the county line. Here and there, however, are a few settlements in which the coals of the Lower Productive group have been exposed, one of these seams being mined in what is known as the Weaver settlement, at the extreme northeast corner of the County. These mines, as well as those in the Graff-McFarland settlement on the western side of the Basin, were examined in 1874 by Messrs. Sanders and Young, and are thus alluded to by Mr. Franklin Platt in his Report of Progress for that year.*

"On S. Pierce's place, near his house, is an old opening on a coal bed, now fallen shut. A shaft put down just alongside of the coal mine found limestone and carbonate ore, not more than 10 to 15 feet below the coal. No measurements could be made. This is on the north side of Wilson's Run, near its head waters.

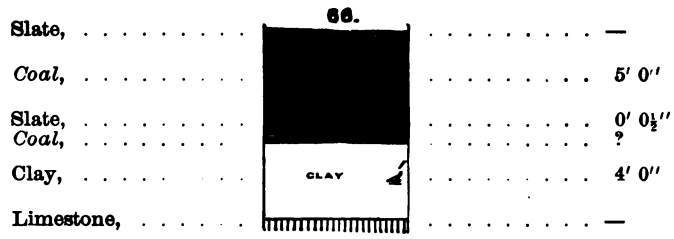
"On the south side of the run, openings have been made on the outcrop, and the same measures were developed; the limestone being in its place under the coal as before. The rocks both above and below the limestone are mainly gray slates. This is probably the Freeport limestone, carrying its usual variable ore on top."

Crossing now to the western side of the Basin, we find a group of mines stretching southwest from the Pierce settlement to and beyond the property of Mr. J. A. White. These mines are apparently working the same coal seam, that seam being *bed D*, which reappears on this western side of the basin, unchanged from its condition on the summit of Chestnut Ridge in Grant township. And the developments on the J. A. White farm show that the coal is here also underlaid by its usual limestone—*the Johnstown Cement seam.*

The coal bed is 5 feet thick in its upper bench, which is the main part of the seam. The lower bench is separated from the upper only by a thin band of slate that is of little or no consequence.

* Report H; Clearfield and Jefferson district.

The coal thus appears in the mine of Mr. L. Gaston, one half mile southwest of Mr. White's:



The limestone underlying the coal has been explored on the White farm, where several feet of good stone have been exposed. It is of a grayish color, apparently non-fossiliferous, requires hard burning to calcine, and slakes down finally into a grayish lime.

Coal bed D with its limestone is easily traced down the North Branch of Little Mahoning, past Tiger's (where it has been opened) to Wm. Widdowson's saw mill, where it seems also to have once been mined high up in the hills. Turning at the saw mill, its outcrop line runs up a branch of Straight Run to reappear on the hilltops at A. State's, 1½ miles southwest of the White farm. It measures 5 feet thick in State's mine where also its accompanying limestone has been found.

At Wm. Widdowson's mill, the heavy boulders of sandstone in the Creek belong most probably to the *Conglomerate of XII.* Between the Creek level and the summit of the hill to the west, indications of coal appear at various intervals on the slope. These outcrops are unexplored. But at the top of the hill 200 feet above the Creek, *bed D* was once opened 4 feet thick, the mine being now closed. The same seam was cut through in sinking a well on the Taylor farm to the west. Here higher seams make their appearance, one of these, two feet thick, outcropping 80 feet above that in the well, while another small seam is visible at the foot of a bench crowning the hill at an elevation of 160 feet above bed D. The highest bed is small and worthless, belonging very probably to one of the Lower Barren seams. The coal alluded to as occurring 80 feet above bed

D is underlaid at an interval of about 10 feet by tough calcareous clay, indicating an outcrop of limestone. This seam was thought to be the *Upper Freeport*, with its limestone in its usual place.

From Wm. Widdowson's mill to Richmond, a distance of four miles on a direct line, the country along Little Mahoning Creek is unimproved forest land, embracing much valuable timber, of which a considerable portion is pine. In this interval of four miles the *Indiana anticlinal axis* crosses the Little Mahoning, passing close to the village of Enterprise, one mile above Richmond and about two miles below the site of the once projected town of Robertsville.

In the gap the *red rocks of XI* are elevated above the water line, but only near the centre of the anticlinal. The *Pottsville Conglomerate* and the *Lower Productive Coal Measures* outcrop in the sides of the gorge. At Josiah Widdowson's (Robertsville) a coal bed identified as D has been opened on the north bank of the stream. Near Richmond, at the opposite end of the gap, some interesting features were observed in connection with the Lower Productive Coal Measures, which have been somewhat more extensively developed in that region than along the upper waters of the North Branch. A description of the country round about Richmond properly belongs to the Marion sub-division of the Fourth Great trough, under which heading it will be found.

Passing southwest from Little Mahoning Creek some important developments on the Lower Productive coals occur in the vicinity of Decker's Point, a region entirely made of the rocks of this system. From the village, near the centre of the trough, the measures rise regularly southeast and northwest towards the enclosing anticlinals, of which the Indiana axis passes close to Beatty's coal bank, upwards of a mile northwest of Decker's Point.

Only the upper half of the Lower Productive group has been explored in this region, the lowest beds of the series being concealed below water level. A section made on the Palmer property starts with the Mahoning Sandrock and extends downwards to bed C, which, judging from its out-

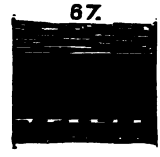
crop, is here small and unimportant. The section is as follows:

Sandstone, Mahoning,	—
Coal, Upper Freeport, (Beatty mine,)	—
Interval,	20′ 0″
Limestone,	—
Interval,	55′ 0″
Coal, Lower Freeport, (S. Palmer mine,)	—
Limestone,	—
Interval,	50′ 0″
Coal, bed D, (Lowry and Barr,)	—
Interval,	45 0″
Coal, bed C, (unexplored,)	—
Little Mahoning Creek, (South Branch,)	—

Such of the interval rocks as were observed in the country about Deckers Point are not included in the above section, this being intended only to show the dimensions of the intermediate spaces between the coals. It is so similar in this respect to the sections already given of these measures that it may stand without comment.

The Mahoning Sandstone is a conspicuous feature of the geology of the region between Decker's Point and Marion, its outcrop being rendered unmistakable by the large boulders and sandstone fragments that in places cover the surface. It is as a general thing coarse grained, compact and heavy, but close to the Beatty mine it is more thinly bedded, and hence less prominent on the surface, but nevertheless quite distinct.

The Upper Freeport coal bed is here in its usual place, beneath this great sandrock deposit. The bed measures 5 feet thick, but includes much bony coal that reduces the workable thickness of the seam to about three feet. Only on the Beatty farm has this coal been explored to any extent in the country round about Decker's Point, the bed being here too impure to justify its development where the lower seams are obtainable above water level. Its outcrop line can be traced by the eye through the fields on to the Palmer farm, where it is near the top of the hill. The following measurement of the seam was made in the Beatty mine:



1. Slate,	—	
2. *Coal*, bony,	1′ 4″	
3. *Coal*,	3′ 2″	5′ 2″
4. Slate,	thin.	
5. *Coal*,	0′ 8″	
6. Slate,	—	

The specimen selected for analysis was taken from No. 3 of the section. It reveals the Upper Freeport bed in a highly impure state; so impure in fact as to be of little value. Mr. McCreath's analysis shows this very plainly:

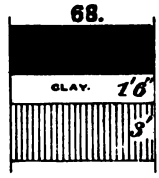
"Water,	.990
Volatile matter,	31.760
Fixed carbon,	52.190
Sulphur,	4.625
Ash,	10.435
	100.000
Coke, per cent.,	67.25
Color of ash,	Lilac.

The coal is very compact; it has a bright shining lustre, with seams of bright pitchy coal running through it. It carries numerous thin partings of iron pyrites and a few knife edges of slate."

The Freeport limestone outcrops 15 feet below its coal on Mr. Beatty's farm. This distance is increased to 20 feet at S. Palmer's, the interval being composed of impure fire clay. The same limestone deposit touches the hills at Barr's and again at Lowry's, but as yet it has been entirely neglected by the farmers.

The Lower Freeport coal has been exposed on the S. Palmer property. It is here from 2′ 2″ to 2′ 6″ thick, being underlaid at a short interval by a band of excellent limestone, that is likewise exposed on the Palmer farm. Most likely this bed corresponds in geological position to that opened on the Miss Hoffman property near Marion, a section of which will be found in a succeeding chapter.

The section in detail of the coal and associated limestone is as follows:



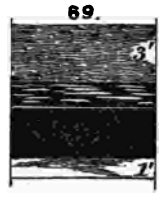
Coal,	2′ 2″–2′ 6″
Clay,	1′ 6″
Limestone,	3′ 0″

The coal, though small, could nevertheless be taken down in conjunction with the limestone, which it would do to calcine; and the limestone being high in carbonate of lime, would produce good fertilizing material. A specimen of the rock gave the following constituents to Mr. A. S. McCreath:

Carbonate of lime,	88.232
Carbonate of magnesia,	1.371
Oxide of iron and alumina,	1.960
Sulphur,	.048
Phosphorus,	.017
Insoluble residue,	8.210

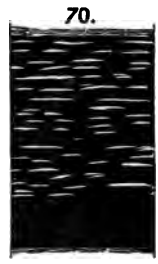
Some little notoriety was recently gained for this immediate section of country by the discovery of *coal bed D* in an unusual condition, and at a thickness wholly abnormal. The excitement was entirely unwarranted by the facts which are briefly these:

Coal bed D as developed on the Barr and Lowry farms (where it is alone exposed hereabouts) shows 2½ feet of bright bituminous coal, remarkably pure and clean, and resting upon an even floor of slate and clay. At the Barr mine this mass of soft coal is immediately overlaid by a bench of smooth cannel slate, 15 inches in thickness, which in turn is roofed by tough black slate, thus:



1. Slate,	3′ 0″	
2. Bony *coal*, cannel slate	1′ 3″	3′ 10″
3. *Coal;* good, soft, friable,	2′ 7″	
4. Ferruginous slates and clay,	1′ 0″	

If we now go to the Lowry property, one half mile north of the Barr mine, we find the cannel slate portion of the bed (No. 2) greatly swollen and increased, although the lower bench (No. 3) of soft pure coal has meanwhile undergone no change whatever and is of exactly the same thickness as at Barr's, thus:



1. Slate, ... —
2. *Bony coal*, cannel slate, ... 8′ 8″ } 10 10″
3. *Coal*, soft, friable, ... 2′7 ″ }
4. Ferruginous slates and clay, ... —

Now at a horizontal interval of 150 feet northeast of this last mine, the same bed was again touched by Mr. Lowry, and in the second opening we see the bed plunging sharply to the southwest, there being a difference of level of 20 feet between the two mines. Moreover, we find in the second opening that the bed gives a section identical in every respect with that in the Barr mine, as follows:

1. Slate, ... —
2. *Coal*, bony; cannel slate, ... 1′ 2′
3. *Coal*, soft, friable, ... 2′ 7′
4. Slate and clay, ... —

All this admits of a very simple explanation. In a word we have here an irregularity that existed in the old Palæozoic surface—a depression extending we know not exactly how far at present, but certainly not farther in a *northwest-southeast* direction than what is now represented by the Barr and Lowry farms. That this depression had rather steep sides, at least at its northwest end, is proven by the steep plunge of the coal in the mine on the Lowry farm last described.

An irregularity similar in many respects to the above occurs in Somerset county at Shoo Fly tunnel on the Pittsburg division of the Baltimore and Ohio R. R.

This latter occurrence was fully described in Report HHH,* and what was said there need not here be repeated, as both irregularities have a like origin. The occurrences however differ in this, that the mud which ultimately swept in and leveled off the inequality of the surface, was at Lowry's mixed with considerable vegetable matter, making the can-

* Pp. 204, 205, 206.

nel slate we now find there, while at Shoo Fly, the overlying slates are not affected by any visible increase in carbon.

The lamination of this cannel slate causes it when struck by the hammer to break regularly and evenly into thin layers parallel to its lines of deposition. Of its quality and its uses as a fuel little need be said; in this particular the chemical analyses given below speak with sufficient distinctness of its almost total worthlessness as a marketable coal; and in a general way the farmers have discovered for themselves that even the more sulphurous fuels are preferable to one of which more than one-fifth of the whole is ash.

Three specimens of the bed were forwarded to Mr. McCreath for analysis. They were all taken from the mine on the Lowry farm where the bed is at its thickest.

Specimen No. I is from near the roof of mine.

Specimen No. II is from the centre of cannel slate bench.

Specimen No. III is from the bench of soft bituminous coal.

The entire mass including the bench of soft coal, which may be said to represent the actual thickness of bed D in this region is very free from sulphur, this being a feature common to all the cannel slates, thus far analyzed from Cambria and Indiana Counties. And it may further be remarked with respect to these cannel slates, that they are singularly uniform in the amount of ash they carry. They almost invariably show about 20 per cent. of this impurity, and have usually less than 1 per cent. of sulphur. For comparison the analyses of cannel slate given in report HH are here reproduced in Table No. 2.

Table No. I: Lowry Property.

	No. I.	No. II.	No. III.
"Water,	.880	.870	1.320
Volatile matter,	23.375	24.485	30.320
Fixed carbon,	50.324	52.964	66.083
Sulphur,	.621	.621	.654
Ash,	24.800	21.060	1.623
	100.000	100.000	100.000
Coke, per cent.,	75.745	74.645	68.360
Color of ash,	Yellowish brown.	Yellowish brown.	Brown.

No. I. The coal is compact, grayish black, cannel like, breaking with conchoidal fracture, with a tendency also to break into plates.

No. II. The coal is compact, grayish black, cannel like, exceedingly brittle, breaking up into plates, with a smooth even surface.

No. III. The coal is deep black, shining, iridescent, tender, with thin seams of iron pyrites."

The amount of hydro carbon gases in the specimens, although apparently varying as much as 7 per cent. between the highest and lowest, bear nevertheless the same relationship to the amount of fixed carbon in the coal, the apparent differences being caused by the variable percentages of slate.

In specimen No. I the percentage of H. C. to C. is 1 : 2.15.

In specimen No. II the percentage of H. C. to C. is 1 : 2.16.

In specimen No. III the percentage of H. C. to C. is 1 : 2.18.

In table No. 2 are given the analyses of two specimens of similar cannel slate in Cambria county. The first of these specimens, obtained from the property of Mr. Burkardt near Fairview village, was analyzed by Prof. F. A. Genth, while the second specimen, analyzed by Mr. A. S. McCreath, was taken from the property of Mr. Moore at the Big Bend of the South Fork of Black Lick:

Table No. 2.

	No. I.	No. II.
"Water,	. . . . .	.340
Volatile matter,	15.20	17.360
Fixed carbon,	60.40	58.294
Sulphur,	0.34	1.806
Ash,	24.40	22.200



PART IV.

THE MARION AND SALTSBURG BASINS IN INDIANA COUNTY.

CHAPTER XVI.

General Description of the Fourth Basin together with a Description of the Saltsburg and Perrysville Anticlinals.

Those townships of Indiana county situated west and northwest of the Third or Indiana anticlinal axis, are in the Fourth Great Basin, which, as will be seen from the map, comprises a considerable portion of the district. On the Conemaugh river this trough is more than fifteen miles wide, extending from the Deep Hollow, two miles below Blairsville, to the mouth of Roaring run, across the Armstrong county line, seven miles below Saltsburg. Prolonged northeast it narrows somewhat by the approach of its sides, but very little, for on the Sandy Lick creek in Jefferson county, 50 miles to the north, its dimensions are nearly the same as they are on the Conemaugh.

With the Fourth Great Axis, the northwestern limit of the Fourth Basin, this Report has little to do, because the anticlinal barely touches the boundary lines of Indiana County. The Armstrong county report will have to deal with this axis from the Conemaugh river to the Mahoning creek, which latter stream is however crossed by the anticlinal inside the limits of Indiana County. It is not intended or desired to anticipate the results of the Armstrong survey, but it is already clearly possible from the work of 1877 to

state confidently, as was done above, that the Fourth Axis of Hodge and Lesley is the Roaring run anticlinal of the Conemaugh and the Waynesburg anticlinal of Prof. Stevenson. It is, moreover, the Port Barnet anticlinal of the Jefferson county report, and it is a continuation of this axis that crosses the P. & E. R. R. between Ridgway and St. Mary's in Elk county.

The small anticlinal axis which crosses the Conemaugh river a short distance *above* Saltsburg, is therefore positively *not* the Fourth axis of the north, but is, as was intimated by Mr. Franklin Platt, in his Report of Progress for 1874, a *sub-axis* splitting the Basin in two. This sub-axis, which so greatly affects the material interests of Indiana county, can be traced only as far north as Rayne township, across Crooked creek, when it dies, expiring completely before reaching the Little Mahoning waters. But on this latter stream, at a point five miles west of where the Saltsburg anticlinal would, if prolonged, cross the Little Mahoning, we find a feeble but nevertheless well marked anticlinal, which traced southward grows steadily weaker and finally dies somewhere, either in Washington or South Mahoning township, but certainly never reaches the Plum Creek Valley. We shall see presently how this axis gains in strength towards the north, and becomes an important anticlinal on the Sandy Lick.

We have then in the Fourth Basin of Indiana county, two distinct and separate anticlinals, both of which die in about the same latitude, causing there an outspread five miles broad of nearly horizontal Barren Rocks. This is the region of East and North Mahoning townships, where the deep valley of Little Mahoning creek is destitute of workable coal beds, as are also the uplands not only of the Mahoning townships, but of the whole elevated country southward to the Conemaugh and beyond. Lower Productive rocks, but only the upper portion of these, are brought to daylight by the sub-anticlinals in the beds of all the principal streams crossing the Fourth Basin; and subsequent chapters relate where and how much of these measures are thus exposed.

The Saltsburg anticlinal comes up through Westmoreland county,* to cross the Conemaugh river between White's Station and Kelly's, nearly three miles above Saltsburg. Northeast of this it bends slightly and runs under a high Barren Measure plateau, keeping a short distance east of Black Legs creek to reappear considerably strengthened on Altman's run, about a mile west of Jacksonville, where it lifts Lower Productives to day light. Beyond this, the axis is again concealed under a thick covering of Barren rocks, until it reaches M'Kee's run, where it makes its presence known in the vicinity of M'Kee's mill, by exposing the Upper Freeport coal for a short distance. It is next seen, and for the last time, on Crooked creek which it crosses near Chambersville, about three miles northeast of M'Kee's mill.

Although Lower Productive rocks are exposed by this axis on Crooked Creek, yet its strength is here clearly diminishing towards the N. E., and in this respect it has lost considerably in running the three miles from M'Kee's mill to Crooked Creek; for if the force exerted had been the same at both places, lower rocks would now be above water level at the centre of the axis in the much deeper valley of Crooked Creek. Going northeast of this we quickly lose hold of the axis altogether and see before us a broad zone of "Barrens" overlapping the sinking anticlinal and covering all northwestern Rayne, the western part of East Mahoning and the whole of North Mahoning township with soft shales and clays, in which there are no productive coal beds.

From indications it would appear that the Saltsburg axis expires close to or on the flank of the Indiana anticlinal, but this fact is not known positively. Thus on the Conemaugh River the two axes named are separated by a distance of seven miles, whereas on Crooked Creek they are scarcely more than three miles asunder. The Saltsburg anticlinal is felt, though very feebly, in the northwestern corner of Rayne, but in East Mahoning township the ex-

* See Report KK, pp. 14, 15, 16.

posures are far too infrequent to permit of the axis being traced through the uplands, and on Little Mahoning Creek, as already stated, there is no trace of it whatever.

Turning now nearly due west and crossing an elevated Barren Measure country for about five miles, we reach the *second anticlinal sub-axis* of the Fourth Basin, in the neighborhood of Sink's mill, on Rosses run, in South Mahoning township. This axis, which I propose to call the *Perrysville*, from a small village near which it runs in Jefferson county, is only a feeble roll on Rosses run, while to the south of this, as was stated above, its existence is entirely unknown. In fact this axis would, if prolonged sufficiently far to the southwest, strike into the heart of the Saltsburg area of the Pittsburg coal bed, which lies in a simple synclinal basin undisturbed by any anticlinal roll.

On Rosses Run, as on Little Mahoning Creek, which it crosses about three miles above Smicksburg, the axis does little more than lift the Upper Freeport coal to daylight; but following the anticlinal across the township we find it rising rapidly, and in the valley of the Big Mahoning, over which it passes between Sellersville and Perrysville, it brings much lower rocks to the surface, supplying the Perrysville country with the abundance of coal found in that region. Mr. Franklin Platt observed the same axis still further north on Sandy Lick Creek, two miles west of Reynoldsville, in which vicinity it "brings up the measures of XII, the Seral [now called Pottsville] Conglomerate, to the railroad and even above it; and from the centre of this subordinate axis westward to the Fourth anticlinal axis at Port Barnet, and beyond, the Sandy Lick Creek flows in the Seral Conglomerate and the rocks just underlying."*

This is sufficient to show with what rapidity the axis must rise between the Mahoning and the Sandy. What becomes of it to the north in Elk and Potter counties, or whether it even extends that far, we are not yet prepared to say.

* See Report on Jefferson County (H), p. 143.

The effect of these sub-anticlinals on the economic value of the Basin will appear without any special elaboration. Without them the trough must have still contained a vast expanse of Pittsburg coal which is now all gone, excepting the small patch at Saltsburg. But on the other hand they so elevate lower measures that easy access can be had at various points in the Basin to the workable seams of the Lower Productive series; and the coal thus easily attainable from the outcrop above water level is ample for the domestic supply for generations to come.

The Fourth Basin section of *the Lower Productive Coal Measures* introduces the Ferriferous limestone of the Allegheny River region. But the horizon of this rock is so seldom exposed in Indiana county, west of the Third or Indiana anticlinal, that the yet unsettled question of its true relationship to the lowest coal beds of the group must be left for later reports. What information could be gathered of the limestone in the district will be found in Chap. XIX of this volume.

Excepting the introduction of this rock into the column, the Lower Productive Coal Measures are the same in the Fourth Basin as they are in the Third or Blairsville trough, so that we have now carried these rocks to the Armstrong county line without finding in them any material modification or change from their condition on the top of the Allegheny Mountain. Little more is now required to enable us to reconcile satisfactorily the hitherto supposed conflicting sections of the Allegheny Valley and the Allegheny Mountain.

Of the Lower Barren group little will be found in the detailed chapters of the Fourth Basin, although these rocks make up nearly the whole of the surface of so much of the trough as is included within the limits of Indiana County. But without further exposures and developments complete sections of this group are impossible, and it therefore only remains to put on record the localities at which well known horizons in the "Barrens" were recognized.

The Upper Productive Coal Measures, of which there is here only a small amount, are confined to the southwest-

ern portion of the trough. They present no new features whatever, appearing in a condition almost precisely similar to that presented at Blairsville, and in all the country to to the south and west.

For convenience of discussion I have divided the Basin into two parts, calling all that east of the sub-anticlinals and between them and the Indiana Axis, *the Marion sub-basin*, from the town of Marion situated in the northern part of the trough; and have denominated as *the Saltsburg sub-basin* the portion lying between the anticlinals and the Armstrong County line. On the Conemaugh river, the Saltsburg sub-basin, properly speaking extends across the Armstrong line to the centre of the Fourth Axis, so that this trough is described only in part in this Report. Further north, in West Mahoning township the entire sub-basin, from anticlinal to anticlinal, is represented within the limits of Indiana County.

Chapter XVII.

Detailed Description of the Marion Sub-basin along the Conemaugh River.

The Marion subdivision of the Fourth Basin embraces all that portion of Indiana County situated *west* of the Indiana anticlinal, and *east* of the Saltsburg and Perrysville sub-anticlinals. On the Conemaugh river it is a narrow trough six and three quarter miles wide, extending from the Deep Hollow, two miles below Blairsville, to near White's Station on the West Pennsylvania railroad. Followed northeastward from the Conemaugh river the width of the sub-basin is steadily diminished by the convergence of its anticlinal sides; but in the Mahoning townships across the "Purchase Line" the Saltsburg axis is obliterated altogether, and the Basin there extends westward to the Perrysville anticlinal, thus giving to the trough in this latitude a width of nearly nine miles.

Besides the town of Marion this sub-basin includes the villages of Covode, Davidsville, Marchand, Georgeville, Kellysburg, Kintersburg, Jacksonville and Fillmore. Economically considered it is the least important of all the Indiana County coal basins, being little more than a trough of Lower Barren rocks, whose geology here is an almost total blank. As much as two thirds and in places perhaps three fourths of the Lower Barren group, are piled up along the synclinal axis, giving to this section gentle slopes and fertile soils, profitable to the farmer and stock grower. But the sections along the principal streams cutting the Basin transversely, show that these rocks, while not totally devoid of coal, nevertheless fail to include a single workable seam.

The Lower Productive Coal Measures are little known

in the southern portion of the Marion sub-basin, and it is not until we have crossed the "Purchase Line" that we find these rocks occupying an extended area above water level. It is true that the Freeport group rises above the drainage line at such points in the valleys of the Conemaugh, Crooked Creek and McKees run, as lie close to the anticlinals; and these exposures though of very limited extent are of great importance to the surrounding country which is thus supplied with cheap fuel both for domestic purposes and for the limekiln.

North of the "Purchase Line," by the uplift of the whole country, the Lower Productive Measures are the surface rocks along all the principal streams in the eastern half of the trough; but by the great expansion of the Basin and the obliteration of the Saltsburg anticlinal before reaching the Little Mahoning, the western half of the trough in this region is composed chiefly of Lower Barren rocks, which we find in the deep valley of the Little Mahoning to the almost total exclusion of the Lower Productive Measures above the surface. Only the highest strata of the latter group outcrop above water level at the point where the Perrysville anticlinal crosses the Creek about three miles above the town of Smicksburg.

The Conemaugh river crosses the Indiana anticlinal near Snyder station in Lower Barren rocks; hence in descending the valley, with the measures inclining very gently northwestward as far nearly as the tunnel on the West Pennsylvania Railroad, we see only Lower Barren rocks, either along the highlands or at the bases of the slopes. Not a trace of the Pittsburg coal bed is found in this Basin north of the Conemaugh river, and the Lower Productive Coal Measures first appear above the Conemaugh in the neighborhood of Waddle's salt works, one half mile below Kelly's station; and although Kelly's station is nearly two miles southeast of the point at which the Saltsburg anticlinal crosses the Conemaugh Valley, yet so gentle is the rise of the rocks towards that axis that in this distance of two miles, scarcely more than 100 feet of Lower Productive Measures are elevated to the day.

Along the Conemaugh there are frequent exposures of Barren Measure shales and slates. This is especially the case in the neighborhood of Livermore, three quarters of a mile above which village "there is a fine natural section of olive shales (40 feet), and blue shales (50 feet), the latter falling into square gravel, and thin scales and splinters. A seeming displacement of the strata appears on two sides of a deep sharp cut. A micaceous sandstone caps the shales a quarter of a mile below Livermore, where the rocks are nearly horizontal; and still higher shales form a high wall for three quarters of a mile lower down the river; these are the 80 feet of shales at the top of the section, which continue exposed until near the tunnel, where a coarse sandstone band is also seen. From the west end of the tunnel the river courses along the strike of the rocks, exposing no different strata for a distance of a mile, when it turns and cuts the second (?) sub-axis, the olive slates forming the high hills on each side.

* * * * * * * * * * *

"The centre of the trough is in the neighborhood of the tunnel, and there is seen a little westward from the west end of the tunnel, on a little run, and only a few feet above the level of the river bed, a band of black and somewhat concretionary limestone from 4 to 6 inches in thickness, containing fossils. The fossils, however, are much more abundant in a band of black ferruginous slate immediately below the limestone; they are mostly Bellerophons with a large species of Ammonite, and a few other molluscs. Black bituminous slate is seen still lower in the bed of the river, and 15 to 20 feet of the same also overlies the limestone; green and mottled slate succeeds above this for 35 or 40 feet. These strata are doubtless the "Black Limestone layers" occurring at about their proper distance beneath the Pittsburg coal. * * * * *

"There is said to have been once discovered in the river bed, below Livermore, a somewhat thick stratum of coal. If such has been the fact, the bed must be regarded as one of the small seams traversing the Barren Measures

at various altitudes, and locally expanded in its thickness."*

The Mahoning Sandstone undergoes a very important expansion in this Marion sub-basin, the expansion being gradual, but continuous westward until this deposit assumes immensely exaggerated proportions and occupies nearly the one half of the entire Lower Barren group, replacing very nearly the whole of the Berlin system of coals. This applies more especially to the Conemaugh country, where the deposit apparently attains its greatest development; for although the rock is scarcely less conspicuous wherever it touches the surface at any more northerly point in the Basin, yet it seems nowhere to reach the dimensions it possesses on the Conemaugh.

Rising above the water line below the tunnel, it quickly becomes the most conspicuous feature in the geology of the Conemaugh Valley as far as Saltsburg. It finally shows three distinct layers of heavy sandrock, separated from one another by no less distinct bands of shale. In this condition it stretches as a nearly vertical wall of rock from below White's Station to the town of Saltsburg. In the Marion sub-division of the Basin, that is, east of the Saltsburg anticlinal, it is not so well exposed on the river, but the outcrops between Kelly's and the tunnel, imperfect as they are, show that the deposit is there as great in bulk as at the town of Saltsburg.

This great increase in the thickness of the Mahoning, while not strictly maintained going west, is nevertheless but little reduced. On Buffalo Creek, in Butler county, it exists as a double deposit, as described by Prof. White,† who called the upper member the Buffalo Sandstone, retaining the name Mahoning only for the lower member of the deposit. Throughout this Report the name Mahoning is applied to the whole deposit, calling the three layers respectively the *Upper*, *Middle* and *Lower Mahoning*, to show the intimate relationship existing between them and the well known and widely distributed Mahoning Sandstone,

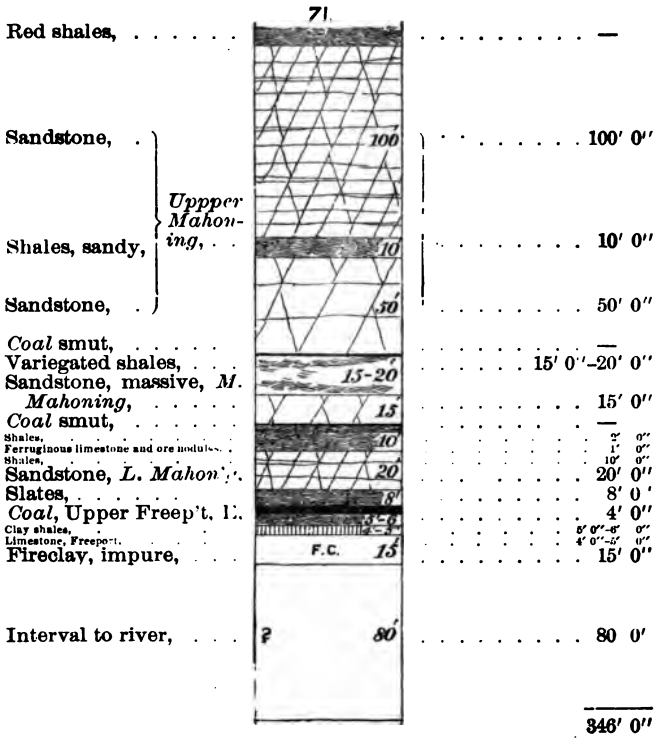
* Rogers' Final Report, Vol. II, pp. 600, 601.
† Report Q., pp. 33, 36.

the three layers being regarded merely as sub-divisions of one great deposit.

Near Saltsburg the base of the Mahoning rests within a few feet of the Upper Freeport coal, being separated from the latter only by a single stratum of tough black slates. The sandstone is here usually fine grained, of a grayish color, much current bedded in places, but often massive and compact. Wherein and at what localities these conditions vary will be found in subsequent chapters.

As already stated, the Lower Productive Coal Measures have little outcrop area on the Conemaugh either in the Marion or Saltsburg sub-divisions of the Fourth Great Basin. What little coal mining is done either at Kelly's or at White's Station is confined entirely to the *Upper Freeport bed*, the *Lower Freeport* seam being certainly above water level but unexplored.

The following section, constructed from exposures on the Conemaugh between Saltsburg and the centre of the anticlinal above White's Station, shows the unusual thickness of the Mahoning Sandstone, as well as the amount of the Lower Productive rocks here above the river bed:



The Upper Freeport coal rises above the Conemaugh between Kelly's Station (Tunnelton) and Mr. Waddle's salt works. Thence it rises slowly on the slopes going west as far as Elders Run, where it rolls over the anticlinal, and then begins to approach again the water line which it touches near White's Station, disappearing beneath the river just beyond. The outcrop line describes a narrow ellipse three miles long, as shown on the map.

The seam carries near the floor a thin parting of bony coal, that runs with great persistency through the bed. It may be mentioned in this connection, as instancing the remarkable evenness with which coal beds sometimes extend, that the section of the Upper Freeport as exhibited on the Conemaugh is identical in every particular with the section of the same bed obtained at Jacksonville, 9 miles northeast of the river. But this similarity and evenness extends no farther than Jacksonville, for at McKees run the bed as-

sumes an entirely different appearance, carrying there an important rider, of which, either at Jacksonville or in the Conemaugh region, there is no trace.

The Upper Freeport coal has been repeatedly opened between Kelly's and White's. It is mined on Mr. Waddle's land close to the salt works, where it is used in boiling the salt water that is here pumped from the sandstone of X (Pocono S. S.). The coal is quite free from slate, but carries an excess of iron pyrites, as shown by the high percentage of sulphur recorded in the analysis given below. The bed measures as follows in Mr. Waddle's mine:



1. Slate,	—	
2. *Coal*,	2′ 0″	
3. Part'g, non persistent,	thin.	
4. *Coal*,	0′ 9″	3′ 9″
5. Parting, bony *coal*,	—	
6. *Coal*,	1′ 0″	
7. Clay slate,	—	

The specimen of this coal, analyzed at Harrisburg by Mr. McCreath, was taken from the top bench, No. 2 of the section. It gave these results:

"Water,	1.220
Volatile matter,	32.570
Fixed carbon,	59.689
Sulphur,	2.151
Ash,	4.370
	100.000
Coke, per cent.,	66.210
Color of ash,	Gray, yellow tinge.

The coal is bright and tender, with numerous thin partings of mineral charcoal and iron pyrites. It contains quite an appreciable amount of calcite in thin scales."

The same bed is also mined at Wining's salt works, on the Westmoreland side of the river, nearly opposite the works of Mr. Waddle. The bed shows the same section and is in like condition at both places. Further down the river the Upper Freeport seam has been touched at several points on both sides of the stream, being worked in a small way for local use.

The Freeport limestone, as shown by the above section (Fig. 71) is here separated from its overlying coal by an interval of only about 5 feet on the average, whereas usually the distance between these strata is 15 feet. The limestone

has been but little worked in the vicinity of Saltsburg. It is exposed on the left bank of the river at Wining's salt works, showing there between 4 and 5 feet of excellent limestone that might profitably be quarried by the farmers and used as a fertilizing element. It is of a brownish color, semi crystalline, and slakes easily, producing a good strong lime. The rock shows numerous impressions of minute shells. A specimen of the stone gave the following results to Mr. McCreath on analysis:

Carbonate of lime,	91.982
Carbonate of magnesia,	1.664
Oxide of iron and alumina,	1.520
Sulphur,	.091
Phosphorus,	.012
Insoluble residue,	4.105

The fire clay shale (of which 15 feet are exposed) that appears underneath the limestone, was once worked to a small extent and made up into bricks in works near Kelly's Station; but nothing is now done with the deposit which from appearances, seems to yield a very inferior quality of clay.

The manufacture of salt at Saltsburg dates from a period early in the present century, but the salt industry has never been very extensively carried on in the valley of the Conemaugh, and what little salt is at present produced is consumed principally in the country round about. The only works now in operation in this immediate region are those of Messrs. Waddle and Wining close to Kelly's Station, the salt water there used, coming as before stated from the sandstone of Formation X, the top stratum of which here underlies the river bed by about 600 feet. The wells near Kelly's station run from 750 to 1,000 feet in depth; no detailed record of the rocks pierced in drilling the holes was kept. In every case the boring was begun a few feet below the Upper Freeport coal.

The supply of the salt water is unfailing, and sufficient for all the demands made upon it. As it comes from the rock it is not specially strong, and the reduction process consequently occupies considerable time. In the end, however, a good clean white salt is produced.

Chapter XVIII.

Detailed Description of the Marion Sub-basin continued Northward from the Conemaugh River to Marion.

If we ascend the northern slopes of the Conemaugh, and proceed northeastward through the Marion sub-basin, we pass, for several miles, over a country in which the Lower Barren rocks cover the surface and fill the shallow valleys. Traces of coal here and there occur in these Barren Measure hills, but they represent only small, worthless seams. Not only in the Marion sub-basin, but throughout the whole of Indiana County, west of Chestnut Ridge, there was not observed a single workable coal bed in the Lower Barren rocks. Possibly these measures may contain seams of coal in the Marion Sub-basin that might repay development in the absence of larger beds, but if any such exist here, they exist only locally, and their presence in those places is unknown at the present time.

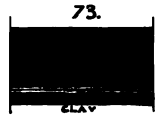
It is not until we have passed Lewisville, and have begun to descend into the valley of Coal run, that we find Lower Productive rocks above water level. Crossing the run, and advancing still further northeast to Jacksonville, on the upper waters of Altmans run, the little valley for a considerable distance is made up almost entirely of Lower Productive Measures.

In the Jacksonville region only the *Upper* and *Lower Freeport coal beds* are mined. The comparatively large area enclosed by the outcrop line of the Upper Freeport coal (see map) is alone sufficient to show how rapidly the synclinal axis of the Basin must rise northeastward from the much deeper valley of the Conemaugh in which the outcrop area of the Upper Freeport coal is very small. The

barometrical levels show this rise in the axis to amount to 300 feet, and as the distance between Jacksonville and the river is a trifle more than six miles in a direct line, the floor of the Basin at the synclinal is here tilted at an angle of 1°. Independently of the rather uncertain barometrical levels, the general topography of the country is sufficient to show the geology.

The Upper Freeport coal bed is found in the valley of a small run that drains westward into Black Legs Creek. In this ravine the coal has been opened four feet thick on the Music farm, where also the *Freeport limestone* has been quarried from out of the bed of the run, about 15 feet below the coal. The stone is of a bluish color, moderately pure, and contains innumerable impressions of minute fossil shells. The same coal and limestone have also been developed further down the run.

Crossing to the headwaters of Coal run these conditions are repeated on the property of Mr. S. C. Kennedy, by whom the coal is mined to a small extent. The bed is four feet thick as before, presenting a section very similar to that obtained in the Waddle mine working the same bed, at Kelly's station in the Conemaugh Valley. At Jacksonville the coal is slaty but less sulphurous than on the Conemaugh. The bed measures thus in Mr. Kennedy's mine:



1. Sandstone, Mahoning,			—
2. *Coal*,		8′ 2″	3′ 11″
3. *Bony coal* and slate,		0′ 3″	
4. *Coal*,		0′ 6″	
5. Clay in floor,			—

The upper bench, No. 2 of the section, is wholly undisturbed by its sandstone roof, from which it is occasionally separated by a thin wedge of slate. Mr. Kennedy's mine is close to the centre of the Saltsburg anticlinal, the measures being nearly horizontal, but showing a slight tilt to the southwest.

The following section shows roughly the geology of Coal run valley at Mr. Kennedy's:

Sandstone,	—
Coal, Upper Freeport: bed E,	4′ 0″
Clay,	6′ 0″–8′ 0″

Limestone,	6′ 0″?
Fireclay and ferruginous shales,	10′ 0″
Sandstone, thin bedded,	—
Concealed rocks,	20′ 0″
Shales,	10′ 0″
Coal outcrop; Lower Freeport: bed D′,	—
Concealed rocks,	30′ 0″
Coal outcrop; bed D,	—
Limestone outcrop? Johnstown cement,	—
Concealed to water level,	10′ 0″

Following down Coal run from Kennedy's the *Upper Freeport* coal ranges along the hill tops. On the Ballantine farm a subjacent coal seam was opened about one half mile above the mouth of the run. The coal is 3½ feet thick, with an insignificant parting near the centre of the bed; it is overlaid by 15 feet of ferruginous shales. The rocks at Ballentine's dip southeast, and the coal there exposed undoubtedly passes beneath the Hazlett mine on the Upper Freeport coal at the mouth of the run, but the exact position of the lower bed in the measures could not be satisfactorily ascertained for lack of reliable dips and exposures.

At Hazletts the Upper Freeport coal is of precisely the same thickness and in the same condition generally as at Kennedy's. The following analysis, made by Mr. A. S. McCreath from a specimen of this coal taken from the upper bench, shows fairly the average condition of the bed:

"Water,	1.180
Volatile matter,	26.500
Fixed carbon,	56.679
Sulphur,	.671
Ash,	14.970
	100.000
Coke, per cent.,	72.320
Color of ash,	Gray.

The coal is bright, shining, compact, slaty, with seams of mineral charcoal."

The Freeport limestone is quarried on the Hazlett property close to the coal mine, which it underlies at an interval of six feet, a reduction of more than one half in the distance between the same strata on the Music farm. Moreover, at Hazlett's the stone shows no fossils; it makes a strong dark lime, well adapted for fertilizing the soil. The whole

of the deposit is not exposed at this place, but there is certainly not less than 6 feet of good stone existing as separate bands, from one of which a specimen was selected for analysis. It gave the following results at the laboratory of the survey (A. S. McCreath):

Carbonate of lime,	89.821
Carbonate of magnesia,	1.801
Oxide of iron and alumina,	1.700
Sulphur,	.133
Phosphorus,	.027
Insoluble residue,	5.430

A break in the bank of the stream shows that the Upper Freeport coal goes beneath the bed of the run just below the Hazlett mine; but the coal reappears in ascending Altmans run, and has been explored on the Jack property. Still further up Altmans run the bed has been again exposed by Mr. Fails, and then again near Jacksonville, on the property of the Rev. Mr. Orr.

At Jacksonville large boulders of sandstone, emanating from the *Lower Mahoning*, are abundantly strewn along the western slopes of the valley, up which runs the Upper Freeport coal, branching off into the numerous small ravines that intersect with the Altmans Valley. Thus the coal has been opened on the Stewart farm and again on the Clawson property, its outcrop being also seen in the road at the Ray farm near the School House.

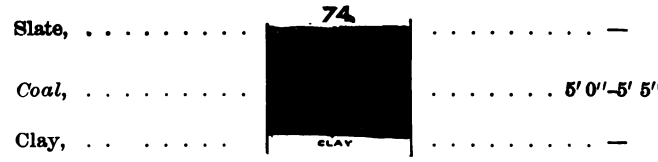
On the branch of Altmans run leading north from Jacksonville the same rocks are exposed. The measures rise in ascending the run towards the anticlinal axis that passes about one mile west of Jacksonville. This axis brings up the *Lower Freeport coal*, which bed has been opened on the Forsythe farm and again on the Neill property, at both which places it shows five feet thick. The bed is very even, quite free from sulphur, but considerably intermixed with earthy material, as shown by the large percentage of ash in the analysis given below. It is the presence of this impurity that gives to the coal its great firmness, causing it to come from the mine in large blocks. An average specimen of the coal analyzed as follows (A. S. McCreath):

"Water,	1.010
Volatile matter,	28.505
Fixed carbon,	55.380
Sulphur,	.700
Ash,	14.405
	100.000
Coke, per cent.,	70.485
Color of ash,	Gray.

The coal has a dull lustre generally, but shows numerous bands of bright, pitchy coal. It carries considerable slate, and breaks with fracture showing oblique faces."

Near the centre of the bed ranges a thin bench of soft pure coal about 0′ 8″ thick. In mining it is taken out separately, being in demand for use in the blacksmiths forges.

The roof of the coal is tough black slate, the floor consisting of hard impure clay, as follows:



The rocks are concealed between the mine and the run, and it is not known whether the Lower Freeport coal is here accompanied by its limestone.

Ascending the hill above the mine we find the *Freeport limestone* outcropping near Mr. Forsythe's house 45 feet vertically above the Lower Freeport coal, and 15 feet below the Upper Freeport seam, which was once opened close to the house, and has a thickness it is said of about four feet.

It is not necessary in this description to follow the outcrop of the *Upper Freeport coal* up the various small ravines that widen towards Altmans run, because the bed has been opened on nearly every farm, and there is no mistaking it, especially as it is the only workable coal above water level in those little valleys. *The Freeport limestone* runs with equal persistency, maintaining an average distance of about ten feet below its coal.

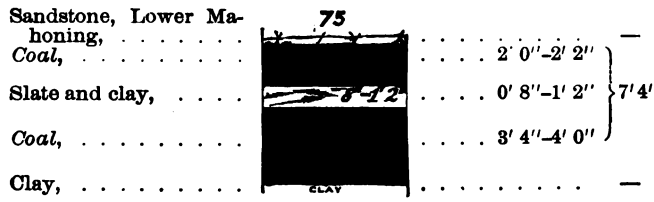
The Mahoning Sandstone is very prominent at some places, and especially so near Mr. J. L. Robinson's house, close to which the Upper Freeport coal is also exposed.

This locality is the extreme northwest limit of the bed above water level on Altmans run.

Advancing northeast, in the Marion sub-basin, from Jacksonville to the valley of McKees run, we pass over a belt of country, the surface of which, as in the region to the south, is composed exclusively of Lower Barren rocks. The area thus crossed embraces the western portion of Centre, the eastern portion of Armstrong, and the northwest corner of White townships. In fact the surface rocks of nearly the whole of the last named township belong to the Lower Barren group, and the county seat situated in the heart of the township, is at least 200 feet above the Upper Freeport coal, and perhaps even more than that. The intervention of the Indiana anticlinal, between the developments on Two Lick and the county seat renders a close calculation of the depth of the Upper Freeport coal below the town impossible without further exposures. A stratum of red shale 20 feet thick has been exposed at the town of Indiana in grading one of the streets near the railroad station. *The Black Fosilferous limestone* outcrops a short distance northeast of Indiana on the road to McKee's mill.

The Saltsburg anticlinal axis crosses McKees run near McKee's mill, lifting there the Upper Freeport coal to water level for a distance of about one half mile. In this valley the coal rises only a few feet above the stream, scarcely high enough to uncover the limestone by which the coal is known to be underlaid. In the neighborhood of McKee's mill the coal can be mined by drift above water level only on the Stuchal and Craven farms, on both of which it has been opened, and found to dip in opposite directions. This locates the centre of the Saltsburg anticlinal within a few hundred yards on McKees run.

The Upper Freeport coal carries here its rider at a short interval above the main bench. This is one of the most characteristic features of the seam on Crooked Creek, and also on lower Two Lick and Yellow Creek. The average section of the coal in the Stuchal and Craven mines is as follows :



The Mahoning sandstone is here very massive, some of its layers being conglomeritic and made up of small pebbles. If we may judge from the extent of its outcrop on the hill slopes, the rock has lost little or nothing either in thickness or massiveness, in running these 20 miles from the Conemaugh river. A stratum of red shale is conspicuous on the hill tops 250 feet above the Upper Freeport coal; this corresponds precisely with what was observed at Saltsburg.

Crossing the water shed between McKees run and Crooked Creek, we find that the Saltsburg anticlinal crosses the latter stream about one mile above Chambersville. In this valley the Freeport group is elevated above water level, but only for a short distance. Coal bed E goes under the stream on a northwest dip at Chambersville, and does not again reappear on Crooked Creek in Indiana County, the Crooked Creek valley being made up entirely of Lower Barren rocks all through Armstrong and Washington townships.

The Upper Freeport coal arches across the Saltsburg anticlinal near Groft's mine, about one mile above Chambersville. Beyond this it quickly disappears in ascending the stream, being carried below the drainage line by a sharp southeast dip.

As mined on the property of the Groft Bros., it is much intermixed with slate, besides carrying a considerable amount of sulphur as iron pyrites. The bed is roofed by the Mahoning sandstone, here as massive and heavy as on McKees run, but the coal is not affected by this contact. The slate parting dividing the rider from the main bench of the seam is in some instances as in the Groft mine, converted into a mass of bony coal the section there being as follows:

1. Sandstone, ... —
2. Slate, usually absent, ... —
3. *Coal*, bony, ... 2′ 5′

4. *Coal*,	3' 6'
5. Clay,	—

But in the Brady mine, ¼ mile below Groft, the parting shows in its usual condition, as a stratam of clay and slate.

An analysis was made of a specimen from the lower bench of the bed with the following results (M'Creath):

"Water,	.950
Volatile matter,	31.420
Fixed carbon,	55.215
Sulphur,	1.215
Ash,	11.200
	100.000
Coke, per cent.,	67.630
Color of ash,	dirty gray.

The coal is bright, shining, tender, and seamed with mineral charcoal and iron pyrites. It also carries a few thin bands of slaty coal."

The Freeport limestone is quarried on the Groft Bro's property, at which place it underlies the coal from 12 to 15 feet. The limestone is reported to have a thickness of 10 feet, but as the deposit has never been entirely exposed, its dimensions are not precisely known. It is, however, of sufficient thickness to be worked with profit, and as it yields an excellent stone, its development would vastly benefit the surrounding country. The deposit holds concretionary masses of calcite. A specimen of the limestone, taken at random from the Groft quarry, gave these results to Mr. M'Creath:

Carbonate of lime,	84.407
Carbonate of magnesia,	2.800
Oxide of iron and alumina,	2.120
Sulphur,	.188
Phosphorus,	.018
Insoluble residue,	9.150

The Mahoning Sandstone is very prominent along Crooked Creek, from Chambersville to Kintersburg, at which latter place the Indiana anticlinal crosses the valley. The enormous boulders of coarse sandrock, with which the surface is thickly strewn, testify to the massiveness of the deposit, while the rocky channels of the small streams

draining into Crooked Creek within this interval furnish abundant evidence of the extent and thickness of this great sandstone.

One affluent of Crooked Creek is Pine Run, flowing from near Marion, through a shallow Barren Measure valley, past Kellysburg, and into Crooked Creek, near the point where this stream is crossed by the Punxsutawney road.

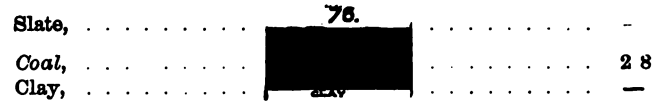
The Upper Freeport coal is below water level, at the mouth of Pine Run, and the little valley is filled with huge boulders of sandstone to the outskirts of the village of Kellysburg. The small coal seam 2 feet thick, found between Mr. McCloskey's mill and the mouth of the run, belongs in the Mahoning sandstone, and is probably not less than 100 feet above the Upper Freeport coal.

At Kellysburg the narrowly contracted and rocky valley of Pine run expands under the disappearance of the Mahoning, which in turn gives place to higher and softer rocks. The developments of Mr. St. Clair Thompson have fully demonstrated that this valley is barren of workable coals until the eastward course of the ravine has carried it to Marion, where the upper portion of the Lower Productive Coal Measures has been pushed above the present drainage line by the Indiana anticlinal axis, on the western flank of which the town of Marion is situated.

Before discussing the developments and exposures at Marion, the small area of Lower Productive Measures above water level in the vicinity of Kintersburg should be noticed.

As already stated, the Indiana anticlinal crosses Crooked Creek near Kintersburg, the point of crossing being at the mouth of Rayne's run, nearly a mile above the village. The axis here elevates above the level of Crooked Creek a considerable portion of the Lower Productive group, the section at Kintersburg being sufficiently complete to show that the various coal beds, as low down in this system as *bed C*, are present for some distance above water level. The section in all its main features does not differ materially from the same rocks as developed on the Conemaugh river.

At the centre of the axis *Bed C* is opened on the two adjoining properties of Messrs. Walker and Carney, close to Crooked Creek. The bed as here exposed shows thus:



On Crooked Creek, about ¼ mile below the Walker mine, a band of limestone marks the outcrop of the *Johnstown Cement seam.* It is accompanied by *coal bed D*, which overlies the limestone only by a few feet. The coal has never been explored at this place, but the limestone stratum was once sufficiently exposed to reveal a thick deposit of bluish limestone, in which are some impure argillaceous layers.

Still lower down the creek, evidences of the Freeport group occur in Mr. Kinter's fields. Only the outcrop of the *Lower Freeport bed* is here known. Between its outcrop and the coal seam mined by Mr. Kinter, (which was with some hesitation identified as the *Upper Freeport,*) the *Freeport limestone* makes its appearance, and was at one time partially opened up near Mr. McLaughlin's house, ¼ mile below the Kinter mine.

If the coal mined by Mr. Kinter be the Upper Freeport seam, then the bed is either very much diminished in thickness, or else only its rider is here wrought. On Rayne's run to the east and northeast of Kintersburg, the Upper Freeport coal shows a section similar to that already given as occurring in the Groft mine. Its rider on the Fry property is, however, 2½ feet thick, being overlaid by a crumbling yellowish shale, thus corresponding exactly with the section in the Kinter mine, as follows:

Yellowish slate, soft, ... —
Coal, poor, ... 2′ 6″
Clay, ... —

On the hill top over the mine is a cliff of sandstone, indicating some part of the Mahoning deposit, which becomes more and more conspicuous on the slopes as it approaches water level near the saw mill below M'Laughlin's.

The outcrop of the *Upper Freeport coal* runs up the val-

ley of Rayne's run to within a few miles of Marion. It has been opened in this valley on the Fry property, at which place it goes under water level, dipping rather sharply to the northwest. The section made in the Fry mine is important as showing that the Upper Freeport coal still carries its rider. It reads thus:

Slate and shale,	—	
Coal,	2′ 3″–2′ 6″	6′ 3″
Slate and clay,	0′ 4″–0′ 7″	
Coal,	0′ 8″–1′ 0″	
Slate,	0′ 2″	
Coal,	1′ 6″–2′ 0″	

On a high, gently sloping hill, to the north of Mr. Fry's house, occur several small seams of coal belonging to the Lower Barren Measures; one of these beds is reported to have a thickness of two feet. The following section shows the interval distances between these coals, which latter are easily identifiable with the corresponding beds of the Berlin group:

Highest land; sandstone,	—
Interval rocks,	28′ 0″
Iron ore outcrop, in ferruginous shales,	—
Interval rocks,	22′ 0″
Coal, thin. Price seam?	—
Interval rocks,	30′ 0″
Coal, thin. Coleman seam,	—
Interval rocks,	50′ 0″
Coal. Philson seam,	2′ 0″?
Interval rocks,	10′ 0″
Iron ore outcrop; Johnstown iron ore,	—
Interval rocks,	45′ 0″
Coal. Gallitzin seam,	—
Limestone,	—
Interval, sandstone, Mahoning,	40′ 0″
Coal, Upper Freeport,	—

Marion.

The outcrop line of the Upper Freeport coal winds around the headwaters of Pine run, at the western outskirts of Marion. Thence it skirts the high land to the northeast and descends into the valley of the Little Mahoning creek, passing beneath this stream about a mile and a half below the village of Richmond.

The measures dip northwest from the Indiana anticlinal across Marion. They are not affected anywhere in East Mahoning township by the opposite (southeast) dip of the Saltsburg anticlinal, so that the western portion of East Mahoning has Lower Barren Measures for surface rocks which sufficiently explains the absence of workable coal seams in this township west of Marion.

It is the upper portion only of the Lower Productive group that holds the coals above water level at Marion. The bed chiefly mined in this vicinity is the *Lower Freeport seam*, running here about 3 feet thick on the average.

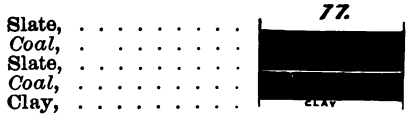
The mines working this bed about the town are situated in a little valley that points southeastward from Marion. The same coal is also worked at the western edge of the town by Mr. Brady, on whose property the conditions are not so favorable for easy and simple mining in consequence of the prevailing northwest dip.

The coal is of very inferior quality. It carries large quantities of ash (slate) and also much sulphide of iron (pyrites). The accompanying analysis, made by Mr. McCreath, from a carefully selected specimen taken from the J. Brady mine, requires no additional comment. It is as follows:

"Water,	.920
Volatile matter,	31.320
Fixed carbon,	57.266
Sulphur,	2.669
Ash,	7.825
	100.000
Coke per cent.,	67.760
Color of ash,	dirty gray, pink tinge.

The coal is bright, shining, iridescent, with numerous thin partings of mineral charcoal and iron pyrites."

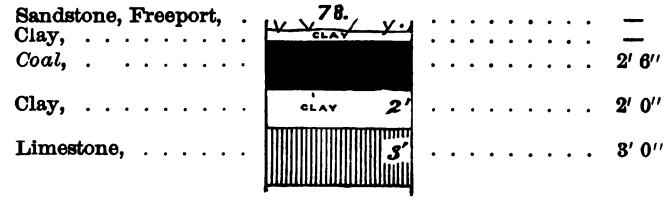
The bed is split in half by a thin but persistent band of slate; it rests regularly upon an even floor of clay, and is roofed by a thick stratum of tough black slate. The following is an average section of the bed as worked at Marion:



The Freeport limestone outcrops on the hillside about fifty feet above the Brady mine, but has never been systematically opened up in this neighborhood. The outcrop of the deposit is also visible high up above the town to the east, and from the extent of its outcrop, the deposit is presumably of considerable thickness. It can easily be traced from farm to farm along the eastern edge of East Mahoning township from the town of Marion to the Little Mahoning valley.

The Upper Freeport coal makes a distinct bench in Mr. Brady's fields, a few feet above the outcrop of the limestone. This coal is almost unknown about Marion, having hitherto been entirely neglected for the Lower Freeport bed. It will be remembered that it is the Upper Freeport that is mined on the Beatty farm on the top of the highlands, 2½ miles east of Marion, and measures there 5 feet thick in all, but yields a very poor quality of coal, more impure, even, than that from the Lower Freeport at Marion.

Ascending the little valley southeast of Marion for nearly a mile we find *coal bed D* above water level on the Miss Hoffman farm, where it shows in conjunction with its underlying *Johnstown Cement limestone* as follows:



The coal is very compact, horizontally bedded, and of a different texture from the Lower Freeport seam, the latter coal having also been exposed on the Miss Hoffman farm near the top of the hill. The limestone is grayish blue, semi-crystalline, fossiliferous, and yields when calcined tolerably good lime. This is the only locality in the neighborhood of Marion at which coal bed D and its limestone have been exposed; the deposit goes under the run a short distance west of Miss Hoffman's house, and is below the surface at Marion.

A small coal outcropping just above the run at Miss Hoffman's house very likely represents *coal C.* Economically it has no importance whatever.

The following rough section made on the Hoffman farm is interesting as showing how little the interval distances between the coals vary at different points in the Basin. Coal bed C is the lowest stratum lifted to daylight in this neighborhood, and is exposed only for a short distance. The southeast rise of the rocks is continued past Miss Hoffman's, but in the highlands overlooking Marion from the east only the top of the Lower Productive group is at the surface. Crossing the anticlinal and descending into the valley of the Little Mahoning at Deckers Point we find the Marion section repeated, as already described in a previous chapter. The section at Miss Hoffman's is as follows:

Mahoning sandstone,	—
Coal outcrop; Upper Freeport; bed E,	—
Interval,	15′ 0″
Limestone outcrop,	—
Interval,	55′ 0″
Coal, Lower Freeport, bed D′,	3′ 0″
Interval,	35′ 0″
Coal, bed D,	2′ 6″
Clay,	2′ 0″
Limestone, Johnstown cement,	3′ 0″
Interval,	35′ 0″
Coal, bed C,	?
Level of run.	

Chapter XIX.

Detailed Description of the Marion sub-basin continued from the town of Marion to the Jefferson County line.

The width of the Marion sub-basin is considerably increased in the Mahoning townships, by the obliteration of the Saltsburg anticlinal. Accompanying this increase in width is a proportionate lateral outspread of Lower Barren rocks, a fact which finds its explanation in great part in the feebleness of the Perrysville anticlinal on the Little Mahoning waters. If we leave out of consideration the country round about Richmond, the Little Mahoning Valley in the Marion sub-basin is devoid of economic importance so far as this remark may be applied to minable beds of coal above water level. The lofty hills that shut in the creek on both sides add little or nothing to the mineral wealth of the county, and have hitherto served only to puzzle the farmer, whose search for coal, either along the slopes or in the smoother uplands, has invariably been attended not only with discouraging results, but with positive failure to find a coal bed that would repay development.

This remark obtains as far down the valley as Georgeville, and even beyond that point, for it is not until we have reached the mouth of Rosses run, five miles above Smicksburg, that we meet with the outcrop of the Upper Freeport coal, which bed here owes its elevation above the creek level to the uplift of the Perrysville anticlinal crossing the valley about $\frac{3}{4}$ of a mile below the mouth of the run. Ascending to the hilltops at this place we see a typical Barren Measure country spreading in every direction from the observer, and embracing within its limits the uplands of the four Mahoning townships, in parts of which the Pittsburg coal bed must narrowly miss the hills.

And not only in the Georgeville region, but further north, at Davidsville, Covode, and Marchand, not a single workable coal bed is known, nor is any such likely to be found above water level at any of the places named. At Perrysville, in Jefferson County, on Big Mahoning Creek, we find repeated the conditions that prevail on Little Mahoning Creek at the mouth of Rosses run, to which allusion was above made. In a word, we see a portion of the Lower Productive Coal Measures dipping very gently southeast from the Perrysville anticlinal, to pass *under* the Davidsville country.

From these remarks it is evident that the geology of so much of the Marion sub-basin as is included within East and North Mahoning townships requires little elaboration. This district is, however, famous for its rich pasture lands and fertile soils; it abounds in limestone that might be more extensively utilized by the farmers. In the vicinity of the village of Covode, a stratum of limestone (apparently high up in the Lower Barrens) is so near the surface as to require almost no stripping to raise it. Other deposits of the same kind of rock are also known in this section of country, but hitherto they have been totally neglected. The following section, consisting entirely of Lower Barren rocks, and constructed along the township road between the Little Mahoning Creek at Sprangle's and the town of Davidsville, may be of interest:

Coal,	Small.
Slates and clay, variegated,	50′ 0″
Sandstone and ferruginous shales,	50′ 0″
Coal,	1′ 0′
Sandy shales and thin sandstone,	20′ 0″
Black slates,	10′ 0″
Coal,	1′ 3″
Interval,	25′ 0″
Limestone,	?
Interval,	10′ 0″
Coal,	?
Interval,	30′ 0″
Creek at bridge.	

The village of Richmond is situated at the western end of the long wilderness gap of the Little Mahoning Creek

through the ridge of the Indiana anticlinal axis. In the vicinity of the village, the hills skirting the creek are chiefly made up of *Lower Productive rocks*, the *Conglomerate of XII* appearing as a range of cliffs that rise slowly on the slopes to arch across the anticlinal at Enterprise one mile above Richmond.

There is, therefore, exposed at the latter place the entire Lower Productive group of rocks; and what makes the section especially interesting is the introduction into it of the great Ferriferous limestone stratum of the Allegheny River region. From this limestone *upwards* in the rocks at Richmond the exposures are sufficiently frequent and complete to enable every necessary connection to be made between the limestone and the Upper Freeport coal, which distance we find to correspond very closely with the same interval on the Allegheny River; but from the limestone *downwards*, to the top of the Pottsville Conglomerate, the exposures are very unreliable and unfrequent, so that it is scarcely possible to determine from this Richmond section the exact relationship existing between coal bed B and the limestone, which in Indiana County is only exposed at this one locality. The survey of the Allegheny River region will settle definitely this question of relationship.

A deposit of coarse heavy sandstone is conspicuous in the bluffs close to the water at the Richmond Bridge. This seems to be the sandrock deposit usually found between A and B coals. The sandstone is 25 feet thick is one compact layer, below which a small coal bed was once opened just above the water line. These strata quickly pass below the Creek, in descending which the coals, limestones, sandstones, slates and clays of the Lower Productive Coal Measures come down from the hills to start on their underground journey beneath the Barren Measure plateau of the Mahoning townships.

The only exposure of *Bed B* (?) in the vicinity of Richmond is on the property of Mr. Leasure, to the west of the village, where it is three feet thick, being separated from the sandstone at the Bridge by an interval of 30 feet. Very

little coal has been taken from the bed, but what has been mined gave satisfaction.

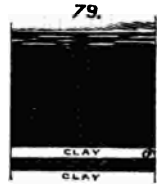
The Ferriferous limestone is quarried on the property of Mr. Isaac Simpson one half mile south of Richmond. It is of a very dark color, very rich in carbonate of lime and highly fossiliferous. Its thickness here has not yet been definitely ascertained, but four feet of excellent stone in one solid band have already been exposed. The deposit is overlaid by a thick stratum of dark fire clay shale. A specimen of the rock from Mr. Simpson's quarry was analyzed by Mr. McCreath with the following results:

Carbonate of lime,	92.857
Carbonate of magnesia,	1.589
Oxide of iron and alumina,	2.030
Sulphur,	.187
Phosphorus,	.035
Insoluble residue,	2.090

The same limestone occurs still further south, on the property of Mr. Jeffries, its outcrop also ranging through the fields to the east of Mr. Simpson's house.

To the east of Mr. Wm. Widdowson's house, a bed of coal, for which a thickness of three feet is claimed, outcrops in a small ravine. The bench of the same coal is conspicuous in Mr. Sutton's fields to the southwest of Richmond; it was estimated to overlie the Ferriferous limestone by a distance of about 40 feet, and represents *coal bed C.*

The next higher bed of the series is that mined on the Jeffries farm about one mile south of Richmond. This is *bed D*, and in a condition very similar to that presented by it on the summit of Chestnut Ridge east of Decker's Point, the section being as follows:



1. Fire clay, slate,		—
2. *Coal*, bony,	0′ 8″	
3. *Coal*,	5′ 3″	7′ 1′
4. Impure clay,	0′ 6″	
5. *Coal*,	0′ 8″	
6. Clay,		—

The bed here yields an impure coal much intermixed with iron pyrites. A fair sample selected from the main bench

of the seam (No. 3 of the section) showed as follows on analysis (A. S. McCreath):

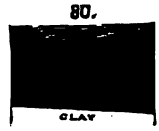
"Water,	.860
Volatile matter,	31.535
Fixed carbon,	59.093
Sulphur,	3.162
Ash,	5.350
	100.000
Coke, per cent.,	67.605
Color of ash,	reddish gray.

The coal is rather tender, with deep black shining lustre. It carries considerable mineral charcoal and a large amount of iron pyrites as thin knife edges."

The same bed was also exposed at one time near Mr. Sutton's house at the base of the hill. The mine was subsequently abandoned for a higher seam (U. F.) and is now shut.

The Lower Freeport bed is small and unimportant in this region. It outcrops in the Marion road nearly opposite Mr. Sutton's house, and was once opened in Mr. T. Johnson's fields to the east of the Jeffries farm. It is about 2 feet thick, having also the same dimensions on the Marion road, where the *Freeport Sandstone* shows in the interval between coals D and D'.

As above stated, the *Upper Freeport* coal has been opened up on the Sutton property. It is underlaid at a short interval by the *Freeport limestone*, which makes a very distinct outcrop in Mr. Sutton's fields, but has not yet been explored there; it is likewise prominent on the Marion road near Mr. Moore's house. The coal bed has further been opened on the adjoining property of Mr. Richardson, showing the following average section in the two mines:

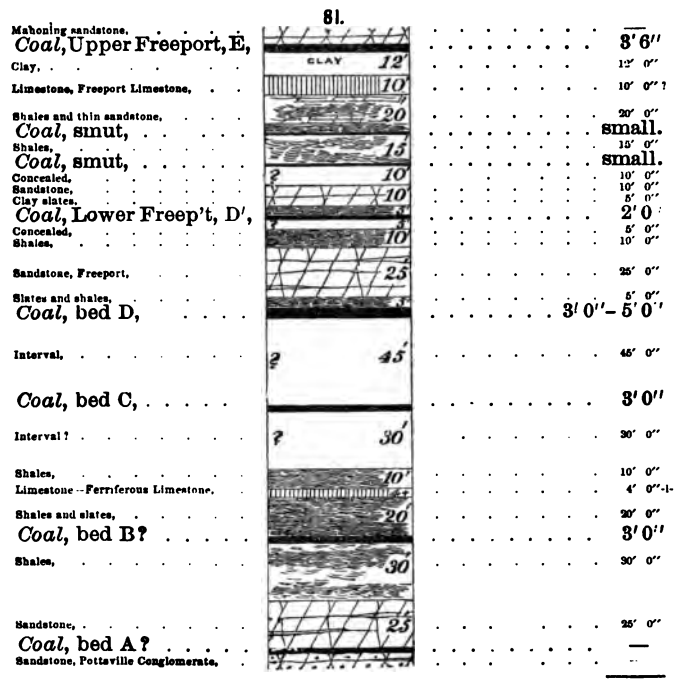


Slate, often soft clay, ... —
Coal, ... 3' 2"–4' 0"
Clay, ... —

The *Mahoning sandstone* is not especially conspicuous in this region, being much current bedded, and crumbling in weathering into loose shales; it is, however, observable on all the slopes above the Upper Freeport coal.

The Richmond section of the Lower Productive rocks as

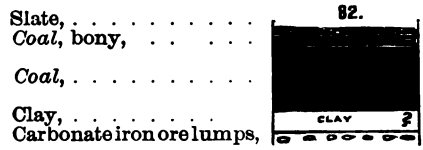
partly compiled and arranged from a number of smaller sections reads as follows:



This section will apply without modification or change to the few developments on the Lower Productive rocks that have been made in the little valleys pointing northward and northeastward from Richmond. And it will also apply in the valley of Canoe Creek, a stream heading near the village of Covode, and flowing thence across the Jefferson county line into Big Mahoning Creek.

One of the Lower Productive coal beds 4 feet thick was opened at the village of Locust Lane, 2½ miles northeast of Richmond; and a similar bed has been exposed near McQuown's mill, close to the southern boundary line of Jefferson County. Several mines have also been opened in Canoe valley, in the northeast corner of Canoe township, on the flank of the Indiana anticlinal. Some of these banks have already been referred to not only in these pages, but

in report H, where several analyses of the coals and ores were given. The coal bed chiefly mined in the Canoe valley was thought to belong to *bed D*, of which the following is an average section, having been obtained in the mine on Mr. Allison's property. It is known locally as the Schlimmer coal:



Mr. F. Platt regarded this coal as identical with the bed worked by Messrs. Wolf, Smith, George Brooks, Spencer and McCullough. Specimens for analysis were secured from the Geo. Graff and McFarland mines. They gave the following results at the Laboratory (McCreath):

	Graff.	McFarland.
"Water,	1.050	1.020
Volatile matter,	29.730	30.190
Fixed carbon,	59.781	57.943
Sulphur,	1.389	2.757
Ash,	8.050	8.090
	100.000	100.000
Coke, per cent.,	69.22	68.79
Color of ash,	Reddish brown.	Cream."

"The coal shows slate partings not persistent. Fifty feet of sandy slates underlie this mine, (Schlimmer) down to the level of Schlimmer's run, and through this whole mass are scattered nodular masses of carbonate iron ore in lumps of all sizes; but in no one place were the ore balls closely enough packed, or the ore plates thick enough to make a workable bed of iron ore. It is reported that a persistent bed of carbonate iron ore of considerable size lies directly under Schlimmer's coal bed; but it could not be seen when the mine was examined.

"A specimen of this Schlimmer iron ore yielded, on analysis, (McCreath):

'Iron,	26.500
Sulphur,	.141

Phosphorus,	.149
Insoluble residue,	34.460

"'The ore is a carbonate, is hard, compact, silicious, of a bluish gray color, with conchoidal fracture.'

"The analyses of these coals in the northeastern end of Indiana County, show considerable sulphur, and also a decidedly large percentage of ash; indicating that the coals of the Third Bituminous Coal Basin as previously found in the same basin farther to the northeast, are clearly inferior in quality to the coals from the Freeport coal beds, in the Fourth Coal Basin southwest of Reynoldsville. And the vertical sections show that they cannot compare in thickness."*

Of the iron ores occurring in this part of the Basin, Mr. F. Platt in the same Report of Progress from which the above was taken, says:

"But it was especially for iron ore that the examination of the region southeast of Punxsutawney was made; and it was, on the whole, unsuccessful. Iron ore deposits were examined, as described above: but in no case could there be found evidence of a regular and persistent bed, excepting the small bed on Wilson's Run, and the ore along the Mahoning Creek at Clayville, and that only picked into on the outcrop. Nodular ore masses in shales, no matter how closely they may be packed together at the outcrop where exposed, afford no reasonable basis for iron works. Such deposits frequently yield and very cheaply, some thousands of tons of excellent iron ore; but they are essentially irregular, changing rapidly, thinning down to nothing without warning, and only regular in this, that they surely bring ultimate loss to those who drive in regular drifts upon them."

*See Report H, pp. 185–189.

Chapter XX.

The Upper Productive Coal Measures in the Saltsburg Sub-basin of Indiana County.

At Saltsburg, as at Blairsville, the Pittsburg coal bed crosses the Conemaugh Valley from Westmoreland into Indiana County, to run upward along the gently sloping floor of the Saltsburg sub-basin as far as West Lebanon. Below Saltsburg on the Conemaugh more than 100 feet of Upper Productive rocks are represented in the hills; and in this condition the Basin continues without much change northeastward from the river for about ten miles, when the entire Upper Productive group is thrust into the air under the influence of the rising synclinal. But the rise of this latter axis is not sufficient to free the country north of Gobblers run of the underlying Lower Barren rocks, and hence we find this latter group of measures overspreading all of Armstrong and Washington, as well as the uplands of South and West Mahoning townships.

This geology is so similar in every respect to that already fully treated in connection with the Blairsville trough, that is only necessary here to describe the openings and exposures made throughout the country north and northeast of Saltsburg.

The Lower Productive rocks, as far as these are exposed on the Conemaugh in the Saltsburg sub basin, have already been sufficiently discussed in a previous chapter. It may not be inappropriate, however, to here repeat, that the highest member of this Lower Productive group, *the Upper Freeport coal bed*, goes under water level at White's Station, about one mile above Saltsburg, and that the *Mahon-*

ing Sandstone, much increased in thickness, makes up the river bluffs at the latter town.

The remainder of the Lower Barren group, from the Mahoning Sandstone upwards, may be seen in part in the steep hills below Saltsburg, hills that are finally crowned, at the old town of Coalport, by the Pittsburg coal bed. Of the Lower Barren group little additional need here be said. It is these measures that make the hills on both sides of Black Legs Creek from the mouth of the stream below Saltsburg to its head springs near West Lebanon; and in all the sections of these measures obtainable in the region under consideration, there is nothing of economic interest, excepting the bands of limestone intercalated in the group. Of the limestones, the *green* and *black fossilferous* layers, may be repeatedly recognized in this subbasin, as may also the *Connellsville* and *Morgantown sandstone*, to which allusion will be made in the detailed description to follow. The following section, though incomplete, shows the greater part of the strata for upwards of 200 feet below the Pittsburg coal. It was made on Harpers run, between Clarksburg and Ashbaugh's mill:

Pittsburg *Coal* Bed,		—
Concealed rocks,		70′ 0″
Sandstone,		5′ 0″+
Fireclay, impure,		5′ 0″
Limestone, fossiliferous,		2′ 0″
Shales,		13′ 0″
Dark red shales,		5′ 0″
Fireclay with limestone nodules,		3′ 0″
Thin olive sandstone; Connellsville, S. S.,		15′ 0″
Variegated sandy shales,		5′ 0″
Concealed: Sandstone, (?)		10′ 0″
Light colored shales and sandstone,		5′ 0″
Reddish ferruginous shales,		5′ 0″
Sandstone forming cliff,	Morgantown sandstone,	15′ 0″
Concealed: Sandy shales,	Morgantown sandstone,	20′ 0″
Shaly sandstone,	Morgantown sandstone,	15′ 0″
Olive shales,		6′ 0″
Red shales,		8′ 0″
Concealed,		10′ 0″
Harper's run at mouth,		—
		217′ 0″

The Saltsburg area of Pittsburg coal is a basin about 9

miles long by about 2½ miles wide. Its limits are geographically clearly defined: on the north by Gobbler's run; on the east by Black Legs Creek; on the south by the Conemaugh river, and on the west by Long Run in Armstrong County.

Nowhere in the Basin is there represented more than 200 feet of Upper Productive rocks, and this only rarely, the average consisting, as before stated, of about one hundred feet of these measures. The highest *geological* ground is at Elders Ridge, 4 miles northeast of Coalport, the following well known strata being caught in this knob:

The Great Limestone,	—
The Sewickley *Coal* Bed,	—
The Sewickley Limestone,	—
The Redstone *Coal* Bed,	—
The Pittsburg Sandstone,	—
The Pittsburg *Coal* Bed,	—

The Great Limestone is known in this Basin only on Elders Ridge, where it exists as several layers separated by variable intervals of shale, the whole deposit being certainly not less than 25 feet thick. On several rounded knolls in this vicinity the limestone makes an abundant outcrop, showing as a grayish non-fossiliferous rock. It was observed in the fields of Mr. J. Smith, near Elders Ridge, the top of its outcrop being 80 feet by barometer above the Sewickley coal bed, the latter having been opened at the foot of the same hill in Mr. Smith's orchard.

On the Smith farm the limestone is capped by a thin bedded sandstone, which extends to the summit of the knoll, and is at least 20 feet thick; the same rock likewise crowns a high knob on the Watson property to the east of Smith's farm. This sandstone figures in Prof. Stevenson's Reports of Progress, and in Greene and Washington counties it was regarded as constituting the division between the upper and lower parts of the Great Limestone.

The Sewickley coal bed is known at several places in the Saltsburg basin, though the area covered by the seam is comparatively small and the seam itself of little consequence. It ranges as a bed from 3 to 5 feet in thickness,

but is nowhere mined at present in the Basin. It is this Sewickley bed which is at the extreme hilltops in the northern bluffs below Coalport, at which place it is 3 feet thick, overlaid by soft shales and resting upon a clay stratum which in turn is underlaid by the Sewickley limestone. Further north, at Elders Ridge, a thickness of 5′ 3″ is claimed for this coal bed by Mr. Smith, who further describes it as a parted seam, but made up of reasonably clean coal. In the vicinity of Elders Ridge the bed may be frequently seen outcropping in the ditches along the roadsides; it should also occur at West Lebanon, in the 140 feet of interval between the latter town and the outcrop of the Pittsburg bed at Evans' mill. It is there, however, entirely unknown, but is most likely present in some form.

The Sewickley limestone, on the Conemaugh river at Coalport, occurs at an interval of 10 feet below the Sewickley coal. The deposit at this place is at least 6 feet thick, composed apparently of good limestone. Elsewhere in the Basin the stratum has not been explored.

The Redstone coal bed is undoubtedly small throughout all this region, and in many places (as for example on the steep bluffs at Coalport) even its outcrop could not be detected. But at West Lebanon it shows as a small streak of coal, regularly developed, and occurring at an interval of 35 feet above the Pittsburg seam.

The interval between the Pittsburg and Redstone coals is chiefly occupied in the Saltsburg basin by the *Pittsburg Sandstone*, here a very massive rock and certainly from 30 to 40 feet thick, thus corresponding with its condition at Blairsville. It makes a range of cliffs near the hill tops overlooking Coalport, and it is also this deposit that fills the little valley of Robinson's run with heavy boulders of sandstone. But the deposit loses somewhat this massiveness of bedding in going northeast, and at the extreme northeast end of the Basin, it is a thin bedded sandstone that weathers down into loose shale. In the latter condition it may be seen almost directly above the Pittsburg coal at Evans' mill, near West Lebanon, where the deposit is in all not over 25 feet thick.

The Pittsburg coal bed appears as a slaty and much parted seam in the Saltsburg basin. Including its partings and roof coal, it ranges from 8 to 11 feet in thickness, maintaining these dimensions with trifling variations from the Conemaugh river to West Lebanon. The coal is very rich in hydrocarbon gases,—richer by from 3 to 7 per cent. than the coal from the same bed at Blainsville. And the few analyses made of it show also that it is here less pyritous than at the latter place.

The coal makes a broad and distinct bench on nearly every slope over which it runs. By means of this bench, and with the aid of the county map, at the end of the volume, the observer in the field will have no difficulty in tracing the bed across the numerous ravines by which the Basin is gashed, to the northernmost end of this coal in Indiana County.

Moreover the bed has been so frequently opened up in this Basin, that allusion here can only be made to such mines as were examined, and in which measurements of the bed were made. Generally speaking only the lower half of the seam is wrought in the Saltsburg basin, the roof coal being so much parted by thin bands of slate, that there is little inducement to take it down in mining. Moreover the shales over this roof coal are so soft and friable that they render this plan of mining almost imperative, without an elaborate and expensive system of timbering.

In the Saltsburg basin the Pittsburg bed exists in three belts of nearly equal size. All of these have their western limits across the borders of Armstrong County, but the great bulk of this coal area is in Indiana County. The first of these belts extends from the Conemaugh river to Big Run, a small stream which empties into Black Legs Creek near Clarksburg; the second belt extends from Big Run, northeast to Whiskey run, while the third area embraces the region between Whiskey run and the headwaters of one branch of Gobbler's run at West Lebanon. Beyond this latter place there are a few small detached outliers of Pittsburg coal, but as before stated this seam does not

cross the main valley of Gobbler's run, 2 miles northeast of West Lebanon.

The deep ravines dividing this coal area in separate belts furnish long lines of outcrop, by means of which all the coal in this Basin could be easily and cheaply mined. The strata are nearly horizontal, the gentle rise from the synclinal only assisting the operations of the miner.

At present the bed is worked in this Basin only in a small way to supply the home market.

Many years ago the coal was quite extensively mined on the Rhea property near Coalport, but developments here terminated when the canal ceased to be used. Further down the river the bed is now being mined below Loyalhanna Station in Westmoreland County by the Loyalhanna Coal and Coke Company.*

The outcrop of the Pittsburg coal bed skirts the high western bluff of Black Legs Creek. In the vicinity of Clarksburg, on Black Legs, 5 miles above Saltsburg, several mines have been opened on the Pittsburg seam. The village of Clarksburg is in Lower Barren rocks, 200 feet below the Pittsburg coal, nearly all the intervening measures being exposed in the little valley of Harper's Run, which joins Black Legs at Clarksburg. For a section of these rocks see page 270.

At Ashbaugh's steam mill on Harper's run, one mile above Clarksburg, the Pittsburg Coal is being mined by Mr. Ashbaugh, and also by Mr. Alms on the adjoining property, the outcrop of the seam here following close to the township road, and crossing it above the mill. A full measurement of the bed in the Alms mine gave the following section:

Clay,			—
Coal,		0′ 4″	
Slate,	Roof *coal*,	0′ 10″	
Coal,		0′ 8″	
Clay, main parting,		0′ 10″	
Coal,		2′ 4″	9′ 10′
Parting,		thin.	
Coal,		1′ 2″	
Bony *coal* and slate,		0′ 4″–0′ 5″	
Coal,		1′ 7″	
Coal in floor,		1′ 8″?	



* See Report KK, pp. 280, 281.

The bed has here little covering, and has in consequence been much stained by percolating waters. The lower bench of the bed is slightly laminated, has a cannel appearance, and is very rich in hydro carbons.

A specimen of the coal from the Ashbaugh mine gave these results on analysis (A. S. McCreath):

"Water,	1.110
Volatile matter,	37.555
Fixed carbon,	53.639
Sulphur,	1.436
Ash,	6.260
	100.000
Coke, per cent.,	61.335
Color of ash,	gray, red tinge.

The coal is compact, shining, iridescent, with numerous bands of bright pitchy coal."

The outcrop of the bed runs up the ravine of Harpers run to Elders Ridge, in which vicinity it is mined on several farms. In one of these openings (that on Mr. H. Ewing's farm, across the Armstrong Co. border) was obtained a very complete measurement of the seam from roof to floor, and as this section differs somewhat from that given above, it may be reproduced:



Slate and coal,
Coal, } Roof division, 0′ 7″
Slate,
Coal, 0 2″
Slate and clay, main parting, 1′ 6″
Coal,
Slate,
Coal, slaty, 0′ 10″ } 12′ 4½″
Slate,
Coal, 1′ 3″
Slate,
Coal, 1′ 6″
Slate,
Coal, 1′ 8″
Slate, —

Crossing now into the deep and irregular ravine of Whiskey run, we find the coal opened on the McMeans property, and again on the McComb farm, about one mile further down the ravine. The bed as here exposed presents no new features.

Advancing still further northeast across the country towards West Lebanon, the coal has been exposed again

and again by the farmers. At the mill of Mr. J. Evans, close to West Lebanon, the bed is somewhat more slaty, one bench (that next to the lowest) assuming here a cannel appearance. The fracture is smooth and slightly conchoidal. An analysis of a specimen of this coal gave the following results to Mr. McCreath:

"Water,	1.460
Volatile matter,	31.995
Fixed carbon,	53.788
Sulphur,	.997
Ash,	11.760
	100.000
Coke, per cent.,	66.545

Color of ash, reddish; coal yields a firm coke.

The other benches of the seam at Evans are less slaty but more pyritous than that just described. The occurrence of the cannel layer is purely local, not having been observed in any other mine of the region. An analysis was also made by Mr. McCreath of a specimen representing about the average run of the main benches, with the following results:

"Water,	1.040
Volatile matter,	36.940
Fixed carbon,	50.850
Sulphur,	1.465
Ash,	9.705
	100.000
Coke, per cent.,	62.02
Color of ash,	Gray.

The coal is very compact and brittle. The lustre generally is grayish black, but the specimen shows numerous thin bands of bright crystalline coal. It carries considerable iron pyrites in minute crystals."

Two other full measurements of the bed were made at the extreme northeast end of the Basin; the first of these being obtained in the R. R. George mine, one mile northwest of West Lebanon. The bed is here at its best; it is quite extensively developed, is very free from impurities, and deservedly bears an excellent reputation. Very little is lost in mining, the coal coming out in large blocks that bear handling well. The specimen selected for analysis is believed

to represent the general average run of the bed at this place. It is as follows (McCreath):

"Water,	1.680
Volatile matter,	34.975
Fixed carbon,	57.000
Sulphur,	.665
Ash,	5.680
	100.000
Coke, per cent.,	63.345
Color of ash,	Reddish gray.

The coal has a deep black lustre, is rather compact, and is seamed with mineral charcoal."

The bed as here exposed is thus parted:

Slate,			—
Coal,	Roof division,	0′ 5″	
Slate,		0′ 5″	
Coal,		0′ 5″	
Slate,		0′ 1″	
Coal,		0′ 2″	
Slate: main parting: roof of mine,		1′ 0″	
Coal,		2′ 2″	9′ 0½″
Slate,		0′ 0¼″	
Coal,		0′ 1½″	
Slate,		0′ 0¼″	
Coal,		2′ 0″	
Slate,		0′ 0½″–0′ 2″	
Coal,		2′ 0″	
Slate,			—

The face of the coal is N. 20° E. and S. 20° W.

In the mine of the Holsten Bros., situated about a mile northeast of West Lebanon, in one of the small detached outliers of coal, the whole of the Pittsburg bed, including also its roof coal, has been exposed, showing a section in which all the partings characteristic of the seam in this region are present. In this mine also is revealed an interesting occurrence, representing a line of ancient erosion in the old swamps and lagoons in which the vegetation for the formation of the coal was collected. Only the lower part of the seam is affected, showing that the current existed during the earlier stages of the development of the bed. The depression caused by the running stream was subsequently filled up with mud, which we now see as

slate and bony coal; it has a lateral width of seventy-five feet, and winds irregularly along a northeast and southwest course, which moreover indicates by its many bends and turns that the little stream flowed sluggishly. That this "slate bar," as it is called by the miners, extends all the way through the Holsten and Craig hill there can be little doubt, for it has been found in all those entries of the Holsten mine that have attempted to cross the line of its path. How much further it may have originally extended we cannot now tell, because subsequent erosion has swept the entire bed from that part of the country in which the line of fault would lead. The "bar" has reduced considerably the minable dimensions of the bed in the Holsten drift, besides rendering necessary a large amount of "dead work" in those portions of the mine affected by it.

Such irregularities are of frequent occurrence in the Bituminous coal beds of Western Pennsylvania, and may be observed prevailing to a greater or less extent, in nearly every coal mine where the gangways and entries are of great length. A trouble of precisely the same nature, and produced by the same causes, but on a much more extended scale, occurs in the shaft of the Millwood Coal and Coke Company in Westmoreland county, at which place also the Pittsburg coal is wrought. The whole nature of the fault at this latter place has been most beautifully exposed by the extensive operations of the Company, and not only the width of the ancient stream but its exact course has been ascertained for a distance of a quarter of a mile.

Chapter XXI.

Detailed Description of the Mines and Developments in the Saltsburg Sub-basin northeastward from West Lebanon.

Crossing Gobbler's run, and proceeding on thence northeast through Armstrong township into the deeper valley of Crooked Creek, Lower Barren rocks alone are seen at the surface. The same measures prevail at Shelocta, which is almost exactly at the centre of the trough, and about 200 feet above the *Upper Freeport coal bed.* A little more than one half mile below the town there is a partial display of Barren rocks, in which the Black Fossiliferous limestone, one foot thick, makes its appearance in the township road at an elevation of 55 feet above the Creek. Nearly 300 feet above this point a fine grained greenish sandstone, believed to belong to the *Connellsville*, covers the surface of a high knob; this would show how small the margin is, by which the Pittsburg Coal bed misses the hills at the centre of the Basin in the Crooked Creek region. At this exposure below Shelocta the rocks dip southeast in obedience to the anticlinal fold (Fourth Axis?) running through the eastern townships of Armstrong County, which elevates Lower Productive rocks above the level of Crooked Creek, but not until this stream has crossed the Armstrong County line. Regarding the Upper Freeport coal and limestone at this exposure the Final Report of 1858 says:*

"The Upper Freeport coal is nearly three feet thick where it is opened from 12 to 15 feet above the stream; roof, slate, several feet, then thin bedded sandstone 25 feet.

* Vol. II, p. 591.

The Freeport limestone is seen with its usually minute shells in the water a few hundred yards lower down, near the confluence of Plum Creek. It may be 9 feet below the Upper Freeport Coal bed.

Advancing now northeast from Shelocta to the village of Five Points, or Marlin's mill, on Plum Creek, we find there exposed a workable bed of coal above water level. The outcrop line of this coal bed has been laid down on the map as representing the *Upper Freeport seam*, in spite of the fact that the entire correctness of this identification could not be satisfactorily established at the time the region was examined. If *not* the Upper Freeport, then it represents a bed in the Lower Barrens which though perfectly possible is here highly improbable. But if it be the Upper Freeport (and it is certainly not a bed *lower* than this in the geological column) then it is difficult to understand why there is not a greater outcrop area of this coal in South Mahoning township, where some of the streams cut much deeper than Plum Creek, while the synclinal seems to rise gently in that direction. Moreover the *Mahoning Sandstone* would appear principally as a mass of shale at Five Points, which does not at all correspond with the condition of this deposit a few miles to the northeast on the Mahoning waters.

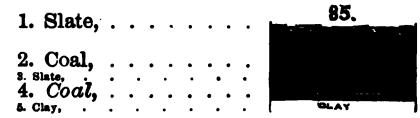
The developments at Five Points are confined to this one coal bed, 3½ feet thick, which ranges along the valley of Plum Creek and keeps close to the water line in Indiana County. It is underlaid at an interval of about 30 feet by a deposit of limestone, which outcrops in the bed of the creek, on the Brown farm, about a mile below the village. Only the upper bands of the limestone can here be raised, and as this part of the deposit contains considerable iron and alumina in its composition, some difficulty has been experienced in slaking the rock after calcination, which latter process only takes place under hard burning. The iron and alumina are not, however, present in sufficient quantities to prevent the use of the rock as a fertilizer. This will appear from the following analysis made by Mr. A. S. McCreath :

Carbonate of lime,	84.125
Carbonate of magnesia,	5.198
Oxide of iron and alumina,	3.220
Sulphur,	.073
Phosphorus,	.014
Insoluble residue,	6.021

The rock has a bluish tinge, and is fossiliferous.

The overlying coal bed has been repeatedly opened in the vicinity of Five Points. It is horizontally bedded and mines out in firm blocks, and yields in general an excellent fuel. Like all the coals in this Basin, it is rich in hydrocarbon gases.

The outcrop of the seam extends up Sugar Camp run for a mile above the village, in which interval it has been opened on several farms, these mines supplying the neighborhood with what coal is needed for domestic purposes. At Five Points the bed shows the following section in the mine of Mr. D. Marlin:



Dip at Five Points very gentle to S. E.

From the main bench (No. 2) of the bed as here exposed a sample of coal for analysis was secured which gave the following results (McCreath):

"Water,	1.100
Volatile matter,	31.890
Fixed carbon,	60.736
Sulphur,	1.279
Ash,	4.995
	100.000
Coke, per cent.,	67.01
Color of ash,	Cream.

The coal is bright, shining, tender, and carries numerous thin partings of mineral charcoal and iron pyrites."

It is this same coal bed that has been opened further down Plum Creek, on the properties of Messrs. Brown, Stewart and Repine, in all which mines it shows at the same thickness, and, generally speaking, in the same condition.

At the village of Five Points a thick stratum of red shale outcrops in the road 40 feet above the coal. This is an unusual feature in the rocks at such a distance above the Upper Freeport seam.

On the property of Mr. S. Carpenter a thin band of lean ironstone has been exposed in the bed of a small run, 70 feet by barometer above the coal opened on the Stewart farm. If our identification of the coal be correct, this ore is in place for the *Johnstown* stratum. It is here overlaid by the following rocks:

Small *coal* seam,	—
Interval,	70′ 0″
Coal,	0 4″
Slate,	0′ 3″
Coal,	0′ 8″
Clay shale,	5′ 0″
Sandstone and shale,	15′ 0″–20′ 0″
Iron ore; greenish, coarse grained,	—

A specimen of the ore was analyzed by Mr. McCreath with these results:

Carbonate of lime,	25.839
Carbonate of magnesia,	3.344
Carbonate of iron,	22.992
Alumina,	7.183
Sulphur,	.010
Phosphorus,	.201
Insoluble residue,	38.220

Between the village of Five Points and the village of Plumville, in South Mahoning township, the country is a beautiful rolling upland of Lower Barrens, and hence destitute of workable beds of coal above water level. But in the valley of North Plum creek, below Plumville, the *Upper Freeport coal* regularly developed, comes to daylight under the influence of the Fourth Axis, already alluded to, which, in going northward, continues to approach the Indiana border, until it finally cuts the extreme northwest corner of this county, to run thence into Jefferson.

The coal rises very slowly above the creek, and as far as the Armstrong county line keeps close to the water's edge; but going east the dip carries the seam under Plumville where it can only be mined by shafts. It shows four feet

thick, composed of bright coal, somewhat pyritous but not to a very damaging extent. It is almost directly overlaid by the *Mahoning sandstone*, from which it is separated only by a thin stratum of slate. The coal rests upon clay, below which the *Freeport limestone* should outcrop, but this is doubtless below the creek at Wilson's mine, where the coal shows this section:



The overlying *Mahoning Sandstone* is very conspicuous as a moderately coarse grained compact rock, showing in this condition at the Lutheran Church, near the County line.

West Mahoning township, occupying the northwest corner of the County, is cut crosswise by two large streams, which unite at the western edge of the township, close to the Armstrong County line. These are the Big and Little Mahoning Creeks, flowing through deep valleys that, in West Mahoning township are in large part made up of Lower Barren rocks, which latter measures, however, occasionally give place to Lower Productive strata. This latter change takes place only in the lowlands, and then only where these streams are crossed by the anticlinal axes. The most easterly of these folds is the *Perrysville anticlinal*, which runs across the Little Mahoning, near the mouth of Rosses Run, and passes over the Big Mahoning Valley in the northeast corner of the township. The other of the axes is the Fourth Great anticlinal, which continued northward crosses the Sandy Lick at Port Barnet, and southward the Conemaugh at the mouth of Roaring Run.

At the mouth of Rosses run the Perrysville anticlinal lifts the *Upper Freeport coal bed* to daylight, but only for a short distance. It has been several times opened along this line of outcrop, showing always as a bed 3½ feet thick, horizontally bedded, hard, compact and slightly

pyritous. It has been exposed by Messrs. Johnson, Pierce, Ruffner and Griffiths; in the first two of which mines the measures dip gently towards the southeast; and in the other mines the tilt is in the opposite direction (N. W.), thus locating the anticlinal very closely. This northwest dip is what sends the coal *under* the town of Smicksburg where Barren rocks alone compose the hills; but lower down the stream, the same bed again rises above the Creek to ride across the anticlinal, running through the northwest corner of the County. All this is more clearly expressed by the geological map.

Considering this structure and the proximity of the coal bed to Smicksburg, it is not specially surprising that property holders in that vicinity have repeatedly explored the high hills overlooking the town, in the hope of finding there a workable bed of coal. All such efforts have proved futile, it having now been definitely established that the Barren rocks here justly bear their name, so far as this relates to minable seams of coal. It is not that coal beds are absolutely wanting in these rocks at Smicksburg, but it is that they are either so small or so impure as to be entirely worthless.

Limestone, on the contrary, abounds; and among the several layers is the *Black Fossiliferous stratum* which outcrops at about 125 feet above the creek.

The developments of Mr. Stear on the bluff to the north of Smicksburg have exposed the following section:

Hill top,	—
Concealed rocks,	110′ 0″
Small *coal*,	—
Dark shales,	20′ 0″
Black fossiliferous limestone,	—
Concealed rocks,	38′ 0″
Clay shales with iron ore nodules,	20′ 0″
Small *coal*,	0′ 2″
Ferruginous clay shales,	15′ 0″
Coal,	Small.
Impure fireclay,	3′ 0″
Limestone, good,	4′ 0″
Shales,	20′ 0″
Sandstone,	2′ 0″
Slate,	1′ 0″

Coal,	2′ 0″
Sandstone and shales,	15′ 0″
Black slates,	0′ 6″
Coal, poor,	2′ 4″
Concealed,	10′ 0″
Creek level,	—

One of these Barren Measure coals has been opened on the Coleman property below Smicksburg. Its thickness is given as between 2 and 3 feet; the bed is underlaid at an interval of 25 feet by a stratum of good limestone that has been quarried to a small extent and found to produce good lime. The dip of the rocks at this place is to the southeast, showing the synclinal axis to be close to the town of Smicksburg, where, if there is any incline at all to the measures, it is to the northwest.

In descending the creek from Colemans, we rapidly approach the Fourth Axis, the presence of which is made known, not only by the change in the dips, but by the reappearance of Lower Productive rocks above the creek level. At Good's mill, close to the Armstrong county line, and near the mouth of Little Mahoning creek, the *Upper Freeport coal* is 200 feet above the stream, and nearly the whole of the Lower Productive group is therefore exposed at this place.

Only the Upper Freeport coal has been explored at Good's, but other seams, even if small, must occur between its horizon and the creek; one of these, probably *bed D*, but perhaps *bed C*, was once opened 50 feet above water level. Its thickness is said to be between 2 and 3 feet. In the remaining interval of 150 feet between this seam and the Upper Freeport the imperfect exposures reveal nothing of interest.

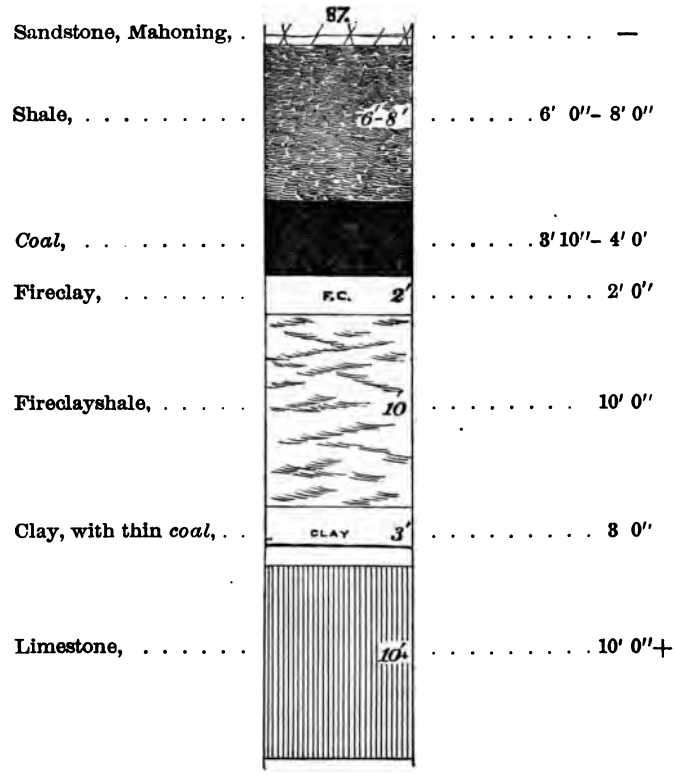
The Upper Freeport coal is here accompanied by its limestone, the interval between the two being exactly 15 feet. The coal bed is without partings of any kind, presenting a breast of clean coal usually 4 feet high. It is of columnar structure, and hence somewhat tender; it ignites quickly, produces a strong heat, and serves admirably to calcine the limestone.

The Freeport limestone is here of considerable value to

the farmer, being composed of excellent stone that readily gives off its carbonic acid, and slakes down into smooth, white lime. The thickness of the deposit is not definitely known, but ten feet of rock have been exposed, and the base of the stratum is not yet reached. It is of a light grayish color; is streaked with thin seams of calcite, but fails to show the small fossils so characteristic of this deposit in Indiana County.

Along the top of the rock ranges a thin streak of coal, to which attention is here especially directed as showing with what great persistency this little coal runs through the county. It has frequently been mentioned in these pages, having been observed as far east as Gillespie's mill on Little Yellow Creek, in the Ligonier Basin.

The following section of the *Upper Freeport coal* and limestone was made on the property of Mr. O. Henry, by whom both strata are wrought:



The geology of the Big Mahoning valley, in West Mahoning township, being exactly the same as that just sketched, it is unnecessity to describe it in detail.

Ascending the creek from the confluence below Good's mill, we pass over Lower Productive rocks until above the "loop" the *Upper Freeport coal* descends to and underneath the creek level. It was here recently opened up on the property of Mr. Chambers, about ½ mile above the "loop," and at the outcrop showed 6 feet of coal. In the bed of the stream, from 15 to 20 feet lower, the accompanying *Freeport limestone* was found.

The *Mahoning sandstone* is very conspicuous in this vicinity, especially at the "loop" where the slopes are covered with large boulders of rock. These boulders disappear almost entirely in ascending the stream, but beyond Sellersville, the Sandstone deposit is again elevated by the Perrysville anticlinal, which crosses the stream near the Gosman farm.

The Perrysville anticlinal, as before stated, brings Lower Productive rocks to daylight on Big Mahoning, just as it does on Little Mahoning to the south. The coals developed by Mr. Gosman undoubtedly belong to the Freeport group. Of the coals only the Lower Freeport has here been explored; it is four feet thick. Thirty feet higher on the slope the Freeport limestone outcrops, but is undeveloped, and 15 feet still higher there are sufficient evidences of the Upper Freeport seam. Ascending the creek to Perrysville, in Jefferson county, these Lower Productive coals are mined quite extensively.

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